MASS. EA13.102:M38/3/996 ✓

Massachusetts Bays 1996 Comprehensive Conservation & Management Plan

AN EVOLVING PLAN FOR ACTION

GOVERNMENT INFORMATION
JAN 2 0 1998
University of Massachusetts
Depository Copy

SUMMARY

MASSACHUSETTS BAYS PROGRAM
ENVIRONMENTAL PROTECTION AGENCY
& EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS

1996 FINAL CCMP

UMASS/AMHERST
31206601652962 3

The Bays Program

The Massachusetts Bays Program is a joint effort of local, state, and federal governments, as well as citizens, scientists, educators, and businesses, to develop regional solutions to pollution problems in the Bays and their adjacent watersheds. The Program is funded under the Clean Water Act through the U.S. Environmental Protection Agency, and is administered by the Massachusetts Executive Office of Environmental Affairs' Coastal Zone Management Office. In addition to developing a long-term plan to improve water quality management, the Program offers information and technical assistance on innovative, locally-based pollution prevention and remediation projects, and sponsors a multi-faceted public outreach and education effort to heighten awareness of pollution problems and to enlist support for and participation in Bays protection.

For more information, call **1-800-447-BAYS** or write to the Massachusetts Bays Program, 100 Cambridge Street, Room 2006, Boston, MA 02202.

Table of Contents

I. Introduction 1

II. The State of the Bays 4

III. Overview of Coastal Subregions 13

IV. Projects of Regional Scope and Impact 14

V. Action Plan 20

VI. Implementing the CCMP Throughout the Bays Watershed 29

VII. Financing the CCMP 33

VIII. Monitoring CCMP Implementation 34

Appendices

A. MBP Research and Demonstration Projects 38

B. MBP Committees and Staff 46

C. Bibliography 53

Acknowledgements 57

Note:

Additional Chapters found in the full CCMP include Base Programs Analysis, Federal Consistency Analysis, and Public Participation/Public Responsiveness Summary.

1

Introduction

History of the Massachusetts Bay Program

The Massachusetts Bays Program was launched in 1988 to actively address the mounting environmental threats to the health of Massachusetts and Cape Cod Bays (the Massachusetts Bays). Initial funding of $1.6 million from the Massachusetts Environmental Trust was the result of settlement fines from a suit filed by the U.S. Environmental Protection Agency and the City of Quincy against the Commonwealth for violations of the Clean Water Act in Boston Harbor. The same year, Congressman Gerry Studds, acting on behalf of the Massachusetts Congressional Delegation, drafted an amendment to the Clean Water Act, giving priority consideration to Massachusetts and Cape Cod Bays to become part of the National Estuary Program (NEP). The NEP was established to identify nationally-significant estuaries threatened by pollution, development, or overuse, and to promote the preparation of comprehensive management plans to ensure their ecological integrity.

In April 1990, following submittal of a nomination package from the Commonwealth, EPA Administrator William Reilly accepted the Massachusetts Bays into the National Estuary Program. In November 1990, EPA and the Commonwealth signed a Management Conference Agreement which set forth work to be accomplished over the next five years.

Today, the Massachusetts Bays Program is a federal, state, regional, and local partnership funded by EPA and the Massachusetts Executive Office of Environmental Affairs (EOEA). The MBP is administered by the Massachusetts Coastal Zone Management Office (CZM) - an agency within EOEA - with technical assistance and planning services provided by the Regional Planning Agencies through grants from the MBP.

Structure and Goals of the MBP

As a first step to carrying out the estuary program, a Management Conference was convened to provide a forum for open discussion and collaborative decision-making. The Management Conference oversees the activities of the estuary program and consists of representatives from appropriate federal, state, and local government agencies, regional planning agencies, various user groups, public and private education institutions, and the general public.

The Management Conference is organized into a network of committees: Policy Committee, Management Committee (MC) (and its Steering Committee), Technical Advisory Committee (TAC), Local Governance Committees (LGCs), and Public Participation Program Committees. The Policy Committee is comprised of the EPA Regional Administrator and the Massachusetts Secretary of Environmental Affairs. This committee approves the decisions of the Management Committee, the major decision-making committee in the Conference. The Management Committee is made up of representatives of state and federal government, the TAC, the five regional LGCs, and the three Public Participation Program Committees (the Coastal Advocacy Network, Education Alliance, and Business and Resource Users Group).

The ultimate objective of the MBP is to institutionalize the water quality management planning process to ensure that a dynamic action agenda is implemented to protect, maintain, and, where necessary, restore or improve the Massachusetts Bays ecosystem. Work under the program has been geared to:

- improving the habitats of living resources in Massachusetts and Cape Cod Bays;
- protecting public health by minimizing risk from environmental contaminants;
- protecting and improving water and sediment quality;
- enhancing the aesthetic quality of Massachusetts' coast and coastal waters;
- encouraging pollution prevention and environmentally and fiscally sound methods of treatment, cleanup, and restoration; and
- improving public access as well as educational and recreational opportunities in and around the waters of Massachusetts and Cape Cod Bays.

Overview of the Comprehensive Conservation and Management Plan (CCMP)

To accomplish the above goals, the MBP has developed a Comprehensive Conservation and Management Plan (CCMP). This plan will serve as the "blueprint" for coordinated action among all levels of government to restore and protect water quality and the diverse natural resources of the Massachusetts Bays estuary.

Charting a New Course

The MBP charted an innovative course among the nation's 28 National Estuary Programs by producing an early version of the CCMP in 1991, the first year of the program's federal funding. Other similar national programs had typically completed several years of scientific research before recommending a course of action. However, the Management Conference believed that, while much remains to be learned about Massachusetts Bays, enough was known already to begin to take action to prevent further degradation and restore the integrity of the Bays ecosystem.

Developing the 1991 Draft CCMP

An all-day "CCMP Development Workshop" was held in March 1991 to design a challenging plan development process. Participants included government officials, environmental advocates, business leaders, and citizens. The workshop resulted in a series of recommendations and the formation of a CCMP Working Group to oversee the development of the 1991 draft CCMP. This document was widely distributed for comment and served to guide the activities of the Program as the Plan was refined and revised over the following four years.

Developing the 1996 Final CCMP

Several important events have helped to shape the 1996 Final CCMP:

Peer Review

In the fall of 1992, a peer review was undertaken by six outside advisors to strengthen and focus the program. Their recommendations included: holding a Visioning Workshop to clarify program priorities, setting measurable goals, defining a long-term regional implementation strategy, and exploring potential funding mechanisms and sources to finance our action agenda.

Visioning Workshop: Setting Priorities and Measurable Goals

A Visioning Workshop was held in June 1993 to help set program priorities. These priorities included reduction of pathogen pollution of shellfish beds and beaches, improved habitat quality, and reduction of toxics and nutrients entering the ecosystem through point and nonpoint sources. Subsequent meetings of an Ad Hoc Committee resulted in the establishment of four measurable goals for the program:

1. Set target values/acres for increased acreage of open shellfish beds over time. Initially, the goal is to reopen the 12 beds identified under the interagency Shellfish Bed Restoration Program;

2. Identify embayments at risk of eutrophication;

3. Monitor improvement in selected biological indicators; and

4. Restore 12 coastal wetlands where restricted tidal flow has led to habitat degradation. Monitor and report the number of acres of coastal wetlands every two to five years to ensure no net loss.

Focus Groups

Early iterations of the CCMP referenced, but did not describe in detail, the major projects of regional significance (so-called "megaprojects") in the Bays region. In order to ensure that the current CCMP provides accurate, informed discussions on these projects, along with appropriate recommendations, a series of focus group discussions were held throughout 1994. Agency representatives and interested members of the advocacy community exchanged ideas and reached agreement on basic steps needed for protection of the Bays environment.

Regional Implementation Strategy

To ensure that the CCMP survives beyond the end of major NEP funding, a series of workshops beginning in January 1994 explored models for a regional approach to facilitate future revision and implementation of the Plan. The principal resulting recommendation focused on institutionalizing the existing partnership between the MBP and the Regional Planning Agencies to provide ongoing technical and financial planning assistance to communities and to promote watershed-based water quality planning. A retreat held in January, 1996, focused on the future role of the Local Governance Committees and reaffirmed their commitment to work towards local implementation of the CCMP. Massachusetts Bays Program staff will continue to provide guidance and technical assistance throughout the implementation phase, and will work closely with the Management Conference participants to monitor CCMP implementation progress.

Financing the CCMP

Implementation of many of the recommended actions in the CCMP will require funding. Accordingly, in 1994, MBP

produced a companion document to the CCMP (*Financing the Massachusetts Bays CCMP: Federal, State, and Local Funding Sources and Mechanisms)* which provides guidance on state and federal sources of funding for implementation, as well as potential local and private sources.

Public Review Process

Throughout the four years since the release of the 1991 Draft, MBP committee members and their constituents have devoted many hundreds of hours to CCMP issues and to development and revision of the document. In addition, in December, 1995, the draft final CCMP was released to the general public for review and comment. The Final CCMP incorporates responses to comments received as part of the public review process, as well as comments on the draft final CCMP from numerous state and federal agencies.

State and Federal Approval

Following approval from the Governor in late winter, 1996, the CCMP was submitted to the EPA for a 3-month review and approval period. A celebration of "graduation" to the official CCMP implementation phase is planned for early fall, 1996.

Plan Organization

The 1996 Final CCMP is organized into 11 chapters. Chapter I introduces the Massachusetts Bays Program and describes its evolving management plan. Chapter II includes a summary of the Characterization Report, a companion document to the CCMP which describes the major features of the Bays - physical, biological, and socioeconomic - and explores the impacts of toxic pollutants, pathogens, and nutrients on the Bays' resources. Chapter III presents specific information on the Bays' five coastal subregions, including important resource management issues. Chapter IV describes a number of major construction projects ("megaprojects") of regional scope and impact in the Bays region. It provides an overview of the history of the projects, summarizing key environmental issues and providing action recommendations for the major agencies and authorities involved. Chapter V, the centerpiece of the Management Plan, presents 15 major Action Plans for preserving and protecting the Bays' resources. Implementation of these plans is presented as a series of targeted steps to be taken by responsible federal, state, and local agencies, with proposed costs and timelines for both immediate and long-term action. Chapter VI presents an overall strategy for implementing the CCMP on a regional (i.e., watershed/embayment) basis. Chapter VII provides information on CCMP financing sources and mechanisms. Chapter VIII describes the scientific and management monitoring programs that will be instituted to gauge progress on achieving MBP goals.

While the remaining chapters are not included in this summary of the CCMP, they describe an approach for evaluating and strengthening the region's existing management network (Chapter IX); an approach for developing an effective and streamlined Federal Consistency analysis (Chapter X); and the MBP's public participation program and the role the general public, environmental advocates, and business community have played, and continue to play, in shaping the CCMP (Chapter XI).

The loose-leaf format of the CCMP underscores its development and purpose as a "living" document, subject to future review and revision. Additional copies, as well as companion documents such as the Financial Plan and the Characterization Report, will be made available through the MBP, CZM, and Regional Planning Agencies.

II

The State of the Bays

Introduction

This chapter describes important natural resource and socioeconomic features of the Massachusetts Bays region. It also assesses the current status of the Bays ecosystem, focusing on priority problems and risks to coastal habitats, living resources, and human health.

To characterize the pollution problems of the Massachusetts Bays and to develop management solutions, the MBP conducted a major research program. This program was conducted by a variety of academic institutions, agencies, and authorities. Included was an in-depth analysis of three diverse embayments: Plum Island Sound, Weymouth Fore River Estuary, and Wellfleet Harbor. The results of this research and related studies conducted by academic institutions, agencies, and authorities were incorporated into the CCMP planning process. In particular, the recommended actions in Chapters IV and V reflect the technical data from the research and studies.

Major Natural Features of theBays Region

Geography, Geology, and Water Movements

The Massachusetts Bays region, shown in Figure 1, encompasses all of the coastal waters of Massachusetts Bay from the tip of Cape Cod to the New Hampshire border, an area of about 1,650 square miles with a shoreline of more than 800 miles. The Bays are located at the southern end of the Gulf of Maine, a large coastal sea characterized by relatively cool water and large tidal ranges. The land draining into the Bays covers more than 7,000 square miles. Half of this area lies within 13 watersheds in Massachusetts; the other half is the watershed of the Merrimack River in New Hampshire.

The Bays region has a diverse geological history. Its shoreline includes numerous beaches comprised of sand and gravel deposited by the glaciers, as well as rocky shores with exposed preglacial bedrock. The underwater topography of the Bays is a patchwork of mud, sand, gravel, and boulders (Knebel *et al.*, 1991).

The MBP provided the funding for the first integrated study of the physical oceanography of the Massachusetts Bays (Geyer *et al.*, 1992). A key step in developing management solutions for the health of the Bays is understanding how pollutants move and are deposited throughout the region. Further, understanding the Bays' currents is essential in predicting how human activities (such as the major sewage outfall under construction in Massachusetts Bay) are likely to impact the marine environment.

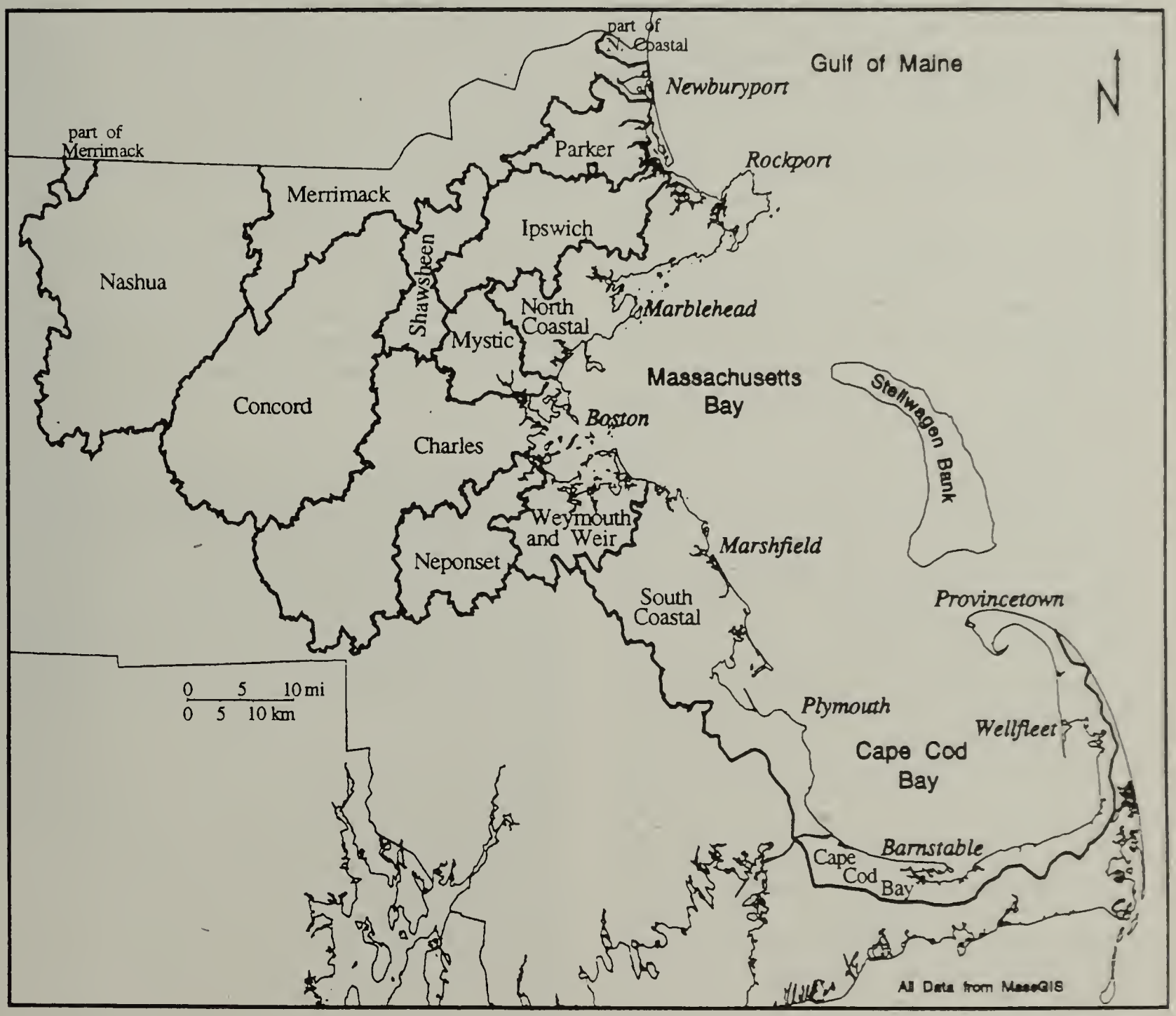
The Bays are strongly influenced by the southward flowing coastal current of the Gulf of Maine. This current, combined with the large flow of water from the Merrimack River, enters northern Massachusetts Bay between Stellwagen Bank and Cape Ann. From there, the water flows southward into Cape Cod Bay, exiting the system around Provincetown. (Some water also enters Massachusetts Bays across Stellwagen Bank under the influence of strong tides.) The overall counterclockwise circulation pattern in the Bays is a yearly average and may vary seasonally and even be reversed on any given day (Geyer *et al*, 1992).

The residence time of water in different parts of the Bays varies from as little as a few days (Boston Harbor and other smaller embayments) to 20 - 45 days (Massachusetts Bays) to over six months (Stellwagen Basin). Particles are flushed more rapidly out of Massachusetts Bay than either Cape Cod Bay or Stellwagen Basin. A study funded by the MBP is examining how the characteristics of Cape Cod Bay influence the physical and biological processes controlling the availability of nutrients, which can be a source of pollution when present in excess concentrations (Gardner *et al.*, in progress).

Compared to other east coast estuaries, the Massachusetts Bays do not contain a high volume of freshwater from rivers. Nonetheless, rivers are important sources of selected pollutants to parts of the Bays (Menzie-Cura, 1991; Menzie-Cura, 1995 a,b) since some pollutants, such as heavy metals and toxic organic compounds, are often adsorbed to particulate matter carried by rivers. Unlike much of the rest of the Bays region, Cape Cod Bay receives almost all of its freshwater inputs from groundwater.

Finally, the Massachusetts Bays undergo an annual cycle of stratification of water into distinct layers by depth. As the water warms in spring, it begins to stratify into a warmer, lighter surface layer, a narrow transitional layer called a pycnocline, and a colder, denser bottom layer. These layers become most pronounced in summer when there is little mixing between the surface and ocean bottom. Cooling temperatures and increasing winds during the fall season break down this stratification by mixing the water.

Figure II-1. The Massachusetts Bays and Their Watersheds



The significance of this phenomenon for the biology of the Bays is that nutrients which support the growth of phytoplankton are used up in the surface waters during stratified periods and are eventually replenished when the waters mix again in the fall (Geyer *et al.*, 1992).

Biological Processes

The patterns of primary production by phytoplankton are related to the stratification cycle described above. As winter moves toward spring, the increased day length initiates a spring phytoplankton bloom, typically in February in Cape Cod Bay and in March in Massachusetts Bay. (Townsend *et al.*, 1990). Under the stratified conditions of summer, the phytoplankton, which must remain in the well lit surface waters, eventually deplete the nutrients, and their growth slows considerably. At the time of the fall turnover and breakdown of stratification, nutrients brought up from the bottom waters stimulate a fall bloom of phytoplankton. The particular species of phytoplankton present at any time also undergo seasonal changes, and can vary from year to year as well.

Productivity and chlorophyll estimates of the Bays are relatively low compared to other coastal regions. The annual productivity of Massachusetts Bay has been estimated at between 300-500 grams of carbon per square meter per year (Cura, 1991; Kelly, 1991; Kelly *et al.*, 1993). Chlorophyll concentrations, an indicator of the quantity of phytoplankton present, range from 1-4 mg per cubic meter per year in most of Massachusetts and Cape Cod Bays. Higher concentrations occur in some harbors and along eastern Cape Cod Bay (Kelly *et al.*, 1993).

Nutrients, particularly nitrogen, are required for the growth of phytoplankton, and hence provide a key to understanding patterns of productivity of the entire system. The largest single source of nitrogen to the Bays is water that enters the Bays from the Gulf of Maine (Cura and Freshman, 1992). The Massachusetts Water Resources Authority's (MWRA) treatment plant on Deer Island is the greatest single land-derived source of nitrogen to the Bays (Menzie-Cura *et al.*, 1991). About 20 percent of the local nitrogen loading to the Bays derives from the atmosphere (Zemba, 1996). In general, nitrogen concentrations in the Bays are highest in harbors and embayments, and then decrease with distance from shore. A study funded by the MBP is examining how the characteristics of Cape Cod Bay influence the physical and biological processes controlling the availability of nutrients, which can be a source of pollution when present in excess concentrations (Gardner *et al.*, in progress).

Cultural eutrophication, the excessive and deleterious growth of algae stimulated by artificially high nutrient inputs, has degraded a number of estuaries around the globe, including Chesapeake Bay and Long Island Sound. Symptoms of such eutrophication are not presently evident in Massachusetts and Cape Cod Bays. Most of the Bays waters are extremely well flushed, although the deep waters of Stellwagen Basin experience occasional depressions of dissolved oxygen in September and October (Geyer *et al.*, 1992). In general, eutrophication in the Bays system is considered a nearshore, localized condition that is limited to smaller embayments.

Most marine organisms depend directly or indirectly on the phytoplankton community. Zooplankton—most commonly microscopic animals related to shrimp and lobster or the larvae of fish and invertebrates—feed directly on phytoplankton as well as each other. The endangered right whale is attracted to Cape Cod Bay in late winter because of the high concentrations of copepods, the most abundant type of zooplankton in the Bays.

Blooms of nuisance algae are a major management concern. Red tide is caused by a dinoflagellate, *Alexandrium tamarense*. This organism produces a toxin that causes paralytic shellfish poisoning (PSP) in humans who ingest shellfish from waters where these organisms have bloomed. In recent years, red tides have been limited primarily to the upper North Shore. One of the major concerns expressed by some about the new MWRA outfall (currently under construction) is that the nutrients it will release may stimulate blooms of the red tide organism transported south from Maine by the overall circulation patterns through the outfall area. Because the overall amount of nutrients will not change and the nutrients will be added below the zone where plankton can grow, most scientific evidence suggests it is unlikely that the new outfall will affect the frequency and extent of red tide blooms (US EPA, 1993). Nonetheless, it is a focus of monitoring efforts. (For more information on the MWRA project, please refer to the "Boston Harbor Project" discussion in Chapter IV.)

Other toxic algae occasionally identified in Massachusetts Bays include *Pseudonitzschia pungens*, which causes Amnesic Shellfish Poisoning (ASP) and *Dinophysis sp.*, which induces diarrhetic shellfish poisoning. *Phaeocystis* (brown tide) is not toxic but is considered a nuisance algae because it fouls beaches, is odorous, clogs fishing nets, and can smother eelgrass and other marine life.

Living Resources Habitats

Massachusetts and Cape Cod Bays are blessed with a diversity of estuarine and marine habitats that are of immeasurable value to the Commonwealth's citizens and to its native wildlife. Protecting and enhancing these habitats is a priority of the Massachusetts Bays Program.

Salt Marshes

Salt marshes are among the world's most productive ecosystems. Currently, there are about 34,000 acres of salt marsh in the Bays region (calculated by MBP from Mass GIS 1985 land use data). Almost half of this acreage is the wide expanse of marsh stretching from Plum Island Sound through Essex Bay on the Upper North Shore. Other large salt marshes are present in Scituate/Marshfield, Duxbury Bay, and Barnstable Harbor.

Over the years, large areas of salt marsh in Massachusetts, particularly in the Metro Boston area, have been destroyed or degraded by filling for urban development (Foote-Smith, EOEA, personal communication). Adoption of the Massachusetts Wetlands Protection Act and accompanying Regulations in the 1970s slowed this trend, but small incremental losses and degradation continue today. These result from commercial development, legal filling (e.g., public works projects), illegal filling, mosquito control, and pollution. Relative sea level rise and the impacts of development in the upland buffer zones adjacent to marshes present future challenges to the health of the Bays' salt marshes. MBP has provided funding to map potential coastal salt marsh restoration sites and to provide a socio-economic justification for restoration of critical marsh areas (King *et al.*, in progress).

Tidal Flats

There are approximately 30,000-36,000 acres of tidal flats in Massachusetts and Cape Cod Bays. About 40 percent of this acreage occurs along Cape Cod Bay in Barnstable County. Duxbury and Plymouth Bays on the South Shore, and Ipswich Bay on the North Shore, also contain extensive tidal flats (Hankin, *et al.*, 1985). In the past, tidal flats have been subjected to the same filling activities that have despoiled salt marshes. In addition to outright loss, tidal flats are also prone to high levels of pollutants since they are areas of sediment accumulation. Tidal flats provide essential habitat for a number of commercially-important shellfish and are major feeding areas for migratory shorebirds, including several threatened and endangered species such as the piping plover and roseate tern.

Rocky Shores

Rocky shorelines constitute the Bays' most dramatic coastal scenery. They are most prevalent in the North Shore region from Nahant north through Cape Ann. Because they are well flushed by wave action, they tend to be less affected by pollutants than other coastal habitats. Nevertheless, even rocky shores can be degraded by severe pollution. Oil spills, in particular, constitute a threat (Whitman, 1994).

Eelgrass Meadows

Eelgrass (*Zostera marina*) forms a rich underwater meadow that is a haven for a variety of fish and invertebrates (Buchsbaum, 1992). Major threats to this habitat include declines in water clarity, dredging, and boating activity (Orth and Moore, 1983; Costa, 1988 a,b). Also, eelgrass is prone to natural population fluctuations resulting from intense coastal storms and a naturally occurring "wasting" disease.

Open Water

The nearshore open water of the Bays extends from the immediate shoreline to a depth of over 300 feet in Stellwagen Basin. Much of this habitat lies within either the Commonwealth's Ocean Sanctuary Program or the Stellwagen Bank National Marine Sanctuary. A major management concern for this habitat is the protection of a number of endangered species, such as whales and sea turtles, that visit the area. Other concerns include fisheries management and maintenance of water quality and habitat integrity in the presence of a number of wastewater outfalls and dredge disposal sites.

Barrier Beaches and Coastal Dunes

Barrier beaches and coastal dunes encompass a complex of habitats, including intertidal areas, upper beach, wrack line, foredune and back dune, washouts, and interdunal swales and forests. These habitats are critical resting and feeding areas for migratory birds, and support a number of unique animals and plants, including various rare or endangered species.

Barrier beaches are the coastal habitat used most intensively by people. As such, they present especially difficult management challenges. Conflicts commonly arise over balancing residential, commercial, and recreational interests with the preservation of the beaches' natural amenities.

Estuaries as Fish and Waterfowl Habitat

Numerous coastal and offshore fish species spend at least part of their lives in estuaries. Although the number of commercially important "estuarine dependent" species is lower here in New England than in other parts of the east coast, these habitats are important nursery areas to several locally valued species, most notably winter flounder. Pollution of some of the Bays' urban estuaries, such as Boston and Salem Harbors, has been associated with a high incidence of disease in this and other fish species (Moore et at., 1995).

The Bays' anadromous fish - those that migrate inland from marine habitats to spawn - include alewives, blueback herring, American shad, rainbow smelt, Atlantic salmon, and Atlantic and short-nosed sturgeon (Reback and DiCarlo, 1972; Chase, 1994). Over the years, these fish have suffered greatly from habitat degradation, particularly in the coastal rivers that are their spawning sites (Chase, 1994). Much of the decline in their populations can be attributed to the restricted access to these spawning sites caused by dams and other physical impediments. Spawning sites also have been destroyed by siltation, excessive growth of algae, and other forms of pollution.

Large wintering populations of sea ducks, gulls, and alcids (penguin-like sea birds) use a variety of the Bay's estuarine and nearshore habitats. In addition, gulls, terns, cormorants, herons, and egrets summer in the Bays region and depend on a number of offshore islands for nesting. The major threat to these birds is habitat degradation, both here in Massachusetts and in the areas where they spend the rest of their migratory lives (Buchsbaum, 1992).

The Human Habitat

In 1992, a major socio-economic analysis of the Bays' resources (Bowen *et al.*, 1992) paved the way for CCMP priority setting.

Population Pressure

People are the ultimate source of most of the water quality problems and habitat degradation in Massachusetts and Cape Cod Bays. The coast of Massachusetts Bays is among the most densely populated of any estuary in the National Estuary Program (NOAA, 1990), and the population is expected to grow - especially in Barnstable County. This growth will spur additional land development, with resulting increases in sewage effluent, stormwater runoff, and other nonpoint sources of pollution.

Shipping, Boating, and Dredging

Boston is the major shipping port in the Massachusetts Bays region, generating $1.858 billion in economic activity, based on 1992 figures from the Massport Authority (Massport, 1995). The recreational boating industry in Massachusetts employs nearly 9,000 workers with a total payroll of $187 million (Cavanaugh and Lewis, 1990). To maintain this shipping and boating activity, Boston and other harbors in the region require periodic dredging. A major and ongoing management issue is the safe disposal of dredged materials, especially those that are contaminated. Other maritime-related concerns are chronic oil spills and bacterial pollution from marine sanitation devices.

Tourism

Tourists in Massachusetts coastal regions spend about $1.5 billion per year and support nearly 81,000 jobs. A major management issue associated with tourism is the conflicts that arise between recreational use and the protection of the Bays' critical coastal resources, especially those on barrier beaches and coastal dunes.

Cultural Resources

The Bays region has a long and rich cultural history, beginning with the first Native American inhabitants of approximately 12,000 years ago (when the continental shelf was exposed as a broad coastal plain) and continuing into the present. A recent survey of data at the Massachusetts Historical Commission (MHC) indicates that the coastal region has the highest density of ancient archaeological sites in the state. Marine resources have been a significant part of Native American subsistence strategies for millennia. European explorers were initially attracted to the Bays for their fishing potential in the 15th century and much of the early colonial settlement was oriented here. Key aspects of the Commonwealth's history are related to its sea-faring industries and dependence on the maritime trades and economies. Important historic and archaeological resources include shipwrecks, marine-dependent structures (e.g., wharves and lighthouses), and various archaeological sites. The latter include Native American habitation areas and villages, historical colonial settlements, and historical marine industries (ships, shipyards, saltworks, fish flakes). Together, these rich cultural resources help define the unique character of the Bays region and provide a better understanding of its historical use and development.

Fishing

Fishing has been an economic and cultural staple of coastal Massachusetts since Colonial times. According to a recent MBP-funded study (Bowen *et al.*, 1992) the total value of fish and shellfish landed in Massachusetts and Cape Cod Bays in 1990 was about $53 million.

Unfortunately, major commercial species are being overfished, resulting in an ecological tragedy that has led to severe economic hardship for traditional fishing-dependent communities, such as Gloucester (Correia, 1992; Buchsbaum *et al.*, in progress). Eight out of 18 species of finfish that occur in the Massachusetts Bays region were

listed as "overexploited" by the Northeast Fisheries Science Center of the National Marine Fisheries Service (NMFS) in their 1993 survey. Total landings of the three most important species of groundfish in Massachusetts waters — cod, winter flounder, and yellowtail flounder — are now only 15 percent of what they were in the late 1970s (EOEA, 1990). Haddock, a species long prized by fishermen and consumers, has all but disappeared from Massachusetts waters.

In response to these distressing trends, NMFS has issued new regulations designed to drastically cut fishing mortality by limiting the areas open to fishing, the length of time fishermen can fish, and the total number of fishermen. At the same time, the Massachusetts Division of Marine Fisheries (DMF) has placed limits on the size of boats that can fish in state waters. Despite these actions, however, recovery of the stocks remains uncertain.

Although overfishing is generally considered to be the primary cause of the current crisis in the fishing industry, pollution and habitat loss are also thought to play a role, especially among fish species that spawn nearshore or are anadromous. In the winter of 1996, MBP hosted a workshop to present the results of a MBP-funded analysis of those factors impacting fish populations (Buchsbaum *et al.*, in progress).

Toxic Contamination of Massachusetts Bays Habitats and Resources

Pollutants in Massachusetts and Cape Cod Bays, such as nitrogen, suspended solids, polycyclic aromatic hydrocarbons (PAHs), chlorinated hydrocarbons, trace metals, and pathogens, can increase risks to human health, habitats, and sustainable resources. These pollutants enter the Bays in either one of two general modes: from point sources (i.e., direct discharges), or from nonpoint sources (i.e., diffuse sources such as stormwater, groundwater, or the atmosphere).

Sources of Pollutants to Massachusetts Bays

Recent studies indicate that the drainage basins for Boston Harbor, the lower North Shore, and the Merrimack River contribute the largest pollutant loads to the Bays. Major sources within these basins are effluent from municipal wastewater treatment facilities and industries, rivers, stormwater runoff, and atmospheric deposition (Menzie-Cura, 1991; Menzie-Cura, 1995 a,b; Golomb *et al.*, 1995).

Wastewater treatment facilities, particularly the large ones run by the MWRA, are among the greatest contributors of trace metals, especially copper, lead, and zinc (Alber and Chan, 1994; Uhler *et al.*, 1994; Menzie-Cura, 1995b). In recent years, the level of metals discharged by MWRA facilities has declined due to an industrial pretreatment program and a slower economy (Alber and Chan, 1994). Industrial pipes are generally not a large "direct" source of toxic pollutants to the Bays, as most industries discharge their wastewater into municipal sewer systems rather than directly into the Bays or their tributaries.

The Merrimack River, which drains the largest watershed to the Bays, contributes an estimated 10-40 percent of the total copper load to Massachusetts Bay. It is also an important source of lead, chromium, and mercury. Many of these pollutants are discharged to the Merrimack River by municipal wastewater treatment facilities and industries in the urban centers along the river (Menzie-Cura, 1991). Rivers entering Boston Harbor are major sources of lead and PAHs (Menzie-Cura, 1991; Alber and Chan, 1994).

Stormwater is a significant cumulative source of pollutants on a Bays-wide scale and a major contributor to the degradation of many nearshore waters, including Boston Harbor. Combined sewer overflows (CSOs) also are a significant contributor of various pollutants to Boston Harbor. Atmospheric deposition is a significant contributor of nitrogen, organic compounds (PAHs and polychlorylbiphenyls, or PCBs), and certain trace metals (cadmium, lead, zinc, and mercury). These pollutants enter the atmosphere from car exhaust and emissions from power plants and municipal incinerators (Golomb *et al.*, 1996; Zemba, 1996).

Concentrations of Toxic Pollutants in the Water Column and Sediments

In general, the concentrations of toxic pollutants in the water column in Massachusetts Bays gradually decrease with distance from shore. In parts of Boston Inner Harbor, Salem Sound, and northern Massachusetts Bay, levels of trace metals exceed those recommended by EPA for chronic toxicity to marine life. In addition, contaminated sediments can be a steady source of some toxic pollutants to the water column.

The contaminant levels in virtually all sediments in the Bays are above background levels, even in relatively pristine Cape Cod Bay (Knebel *et al.*, 1991; Hyland and Costa, 1995; Shea and Seavey, in progress). To assess the impact of contaminated sediments on the community of marine invertebrates inhabiting the sediments, MBP funded a sediment triad analysis (Hyland and Costa, 1995). For a variety of coastal sites, this study compared sediment toxicity, contaminant concentrations, and the health of the benthic community. In most areas of the Bays, contaminant levels are below those thought to impact benthic organisms. Nevertheless, there are a number of toxic "hot spots" in depositional areas where toxic contaminants and high levels of organic matter accumulate, resulting in fewer benthic species (Hyland and Costa, 1995). Nearshore sediments in Boston Harbor, Salem Sound, and Broad Sound contain a long list of potentially toxic compounds at hazardous levels (Moore *et al.*, 1995; Hyland and Costa, 1995; NOAA,

1991). In Boston Harbor, levels of chromium, copper, zinc, lead, mercury, PCBs, and DDT significantly exceed the National Oceanic and Atmospheric Administration's (NOAA's) lowest effect range. Chromium is elevated in Salem Harbor sediments (MacDonald, 1991). The Massachusetts Bay Disposal Site and the future MWRA outfall site both violate EPA's proposed sediment criteria for certain PAHs (Cahill and Imbalzano, 1991).

To further our understanding of the nature of the sediment pollution in the Bays, MBP funded an analysis of pollution levels in cores taken from Massachusetts and Cape Cod Bays (Shea and Seavey, in progress). In addition, MBP funded a review of available sediment pollution data (Cahill and Imbalzano, 1991). These and related studies assist the MBP in understanding the potential impact of major dredging and dredged materials disposal projects in the Bays, as well as characterizing the results of long-term disposal of pollutants into the Bays' waters.

Levels of selected contaminants are expected to decrease in Boston and Salem Harbors as a result of ongoing improvements to wastewater treatment facilities, reduction in CSOs, and the reduced use of certain toxic pollutants, such as DDT, PCBs, and chromium. To help these and other communities implement CCMP actions related to controlling sediment pollution, the MBP funded an analysis of stormwater Best Management Practices and related costs in the Salem Sound area (Battelle, in progress).

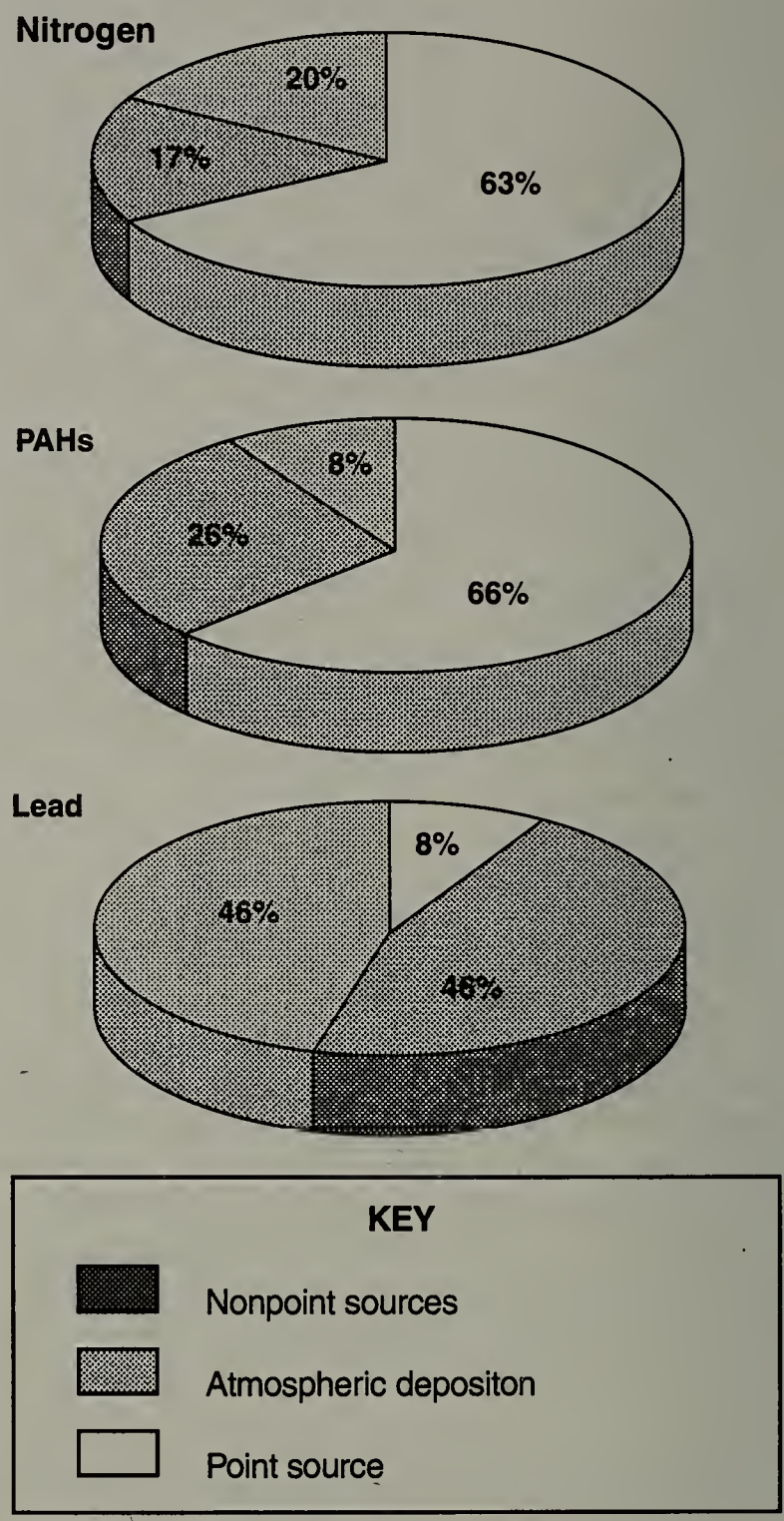
Effects of Contaminants on Organisms in the Bays

Diseases and other physiological effects attributed to toxic pollutants have been found in fish and shellfish from Boston Harbor, Broad Sound, and Salem Harbor (Moore *et al.*, 1995; McDowell *et al.*, in progress). Diseases associated with PAHs (e.g., a precancerous condition of the liver) were much higher in winter flounder from Boston Harbor than in flounder from offshore sites (Sullivan and Robinson, 1990; Moore *et al.*, 1992; Moore and Stegeman, 1993; Johnson *et al.*, 1993). A study by DMF showed that tissue PCB concentrations are elevated in winter flounder and lobsters from Salem Sound and Boston Harbor compared to those from non-urban coastal sites (Schwartz *et al.*, 1991). The effect of toxic pollutants on important marine organisms at the population level is currently being investigated (McDowell, in progress).

To clarify the role of food chain transfer in PAH uptake, the MBP funded a study of PAH metabolism in clams and marine worms (McElroy, *et al.*, 1994). In addition, a MBP study examined a biochemical marker that is induced in populations of fish and intertidal shellfish from the Bays which have been exposed to organic contamination. The marker has the potential to serve as monitoring tool to assess pollution exposure (Moore *et al.*, 1995). These studies and related research will be useful in tracking the recovery of the Bays as the CCMP is implemented.

The risk to humans of consuming fish and shellfish

Major Sources of Pollution to the Massachusetts Bays



Sources of Carcinogenic PAHs in the Bays

Source	Carcinogenic PAHs *(% of total PAHs)*	Total PAHs
Rivers	*1.82%*	*20.0%*
Small Point Sources	*0.54%*	*3.0%*
Major Point Sources	*0.63%*	*63.0%*
Coastal Runoff	*0.31%*	*2.0%*
Atmosphere	*1.08%*	*8.0%*
Dredging	*1.48%*	*4.0%*
Total	***6.00%***	***100.0%***

containing toxic pollutants is assessed by comparing contaminant levels in edible tissues with action levels set by the federal Food and Drug Administration (FDA). In general, fish in the Massachusetts Bays are considered safe to eat by current standards of risk analysis. The only current health advisory is for the consumption of lobster tomalley from lobsters caught anywhere in Massachusetts Bay and a limited advisory for sensitive people for lobster, flounder, and bivalves from Boston Harbor and bluefish from Massachusetts Bay (US EPA, 1988). An EPA study of fish and shellfish in Quincy Bay puts the risk of developing cancer as a result of consuming PCBs in winter flounder, clams, and lobsters (excluding tomalley) at between one in 1,000 to one in 100,000, depending on how regularly the fish or shellfish is consumed (US EPA, 1988). The consumption of lobster tomalley alone posed the highest risk, one in 100.

Most fish advisories in Massachusetts are restricted to rivers and lakes. Health risks associated with consumption of fish from our marine waters, even those of Boston Harbor, are low. Nonetheless, there are some risks, though fish in the Bay are generally considered safe to eat.

Pathogen Contamination of Sustainable Resources

Shellfish Bed Contamination

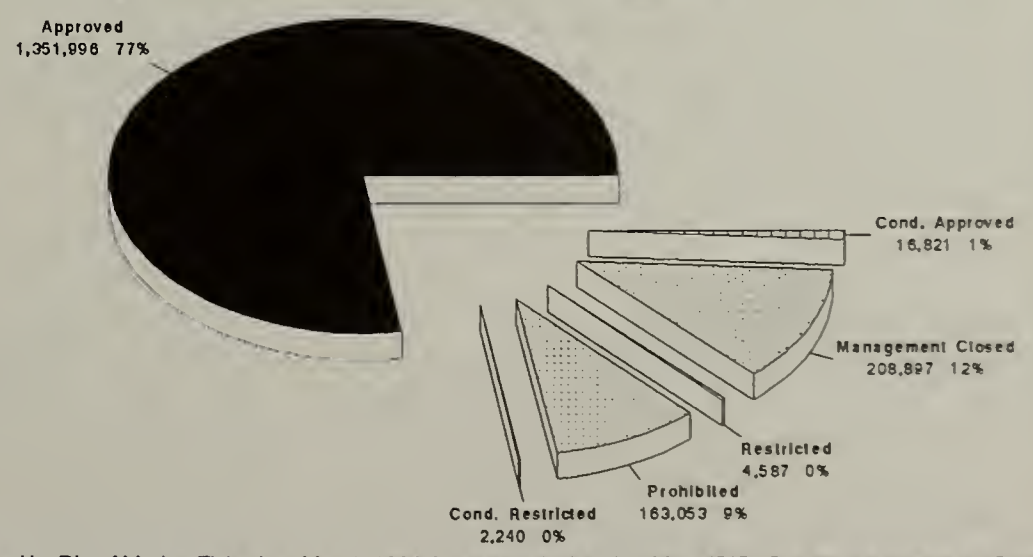
The closure of shellfish beds due to pathogen contamination is, in the eyes of the public, one of the major environmental and economic problems facing Massachusetts and Cape Cod Bays. Indeed, the 80,000 closed acres of shellfish beds represent a significant annual economic loss to the state. A 1991 estimate of the economic loss from closed beds in the Ipswich River alone was $500,000 (Ipswich Shellfish Advisory Board, 1991). Coastwide, the annual losses are many times this amount.

Contaminated shellfish beds are closed to reduce risks to public health from pathogens in sewage. The two most frequent diseases attributed to sewage pollution of marine waters are gastroenteritis (caused by the Norwalk virus) and hepatitis A. Between 1961 and 1984, 6,000 and 1,400 cases of these two diseases, respectively, were reported in the United States (Williams and Fout, 1992). Many cases go unreported. Massachusetts has shown a promising trend of no reported cases over the past few years.

Although fecal coliform bacteria generally do not cause diseases themselves, they are used as an indicator of the presence of pathogens. Shellfish beds are open to harvesting when overlying waters are less than a (geometric) mean of 14 fecal coliform bacteria per 100 milliliters (ml) of water for 15 samples. No more than 10 percent of those 15 samples can exceed 43 fecal coliforms per 100 ml. (See U.S. Department of Health and Human Services, Food and Drug Administration's 1989 Revision of the National Shellfish Sanitation Program's (NSSP) *Manual of Operations, Part I, Sanitation of Shellfish Growing Areas.*) Many shellfish areas in Massachusetts are conditionally approved, meaning that they are open except during certain predictable pollution events, such as rainstorms or sewage overflows. These areas may be closed during certain seasons or classified as restricted, in which case the shellfish can be harvested but must "cleaned" at a relay site or depuration facility for several days prior to marketing. Beds may be classified as "prohibited" due to high levels of fecal coliforms or subjected to management closure because they were not surveyed. DMF has responsibility for monitoring and classifying all shellfish harvesting areas in the Commonwealth.

At the time of this writing, 61 percent, or 252,568 out of 413,341 acres of Massachusetts Bays coastal waters, are classified as permanently open to shellfishing. As mentioned above, 80,000 acres of the total closed acreage is considered productive (i.e., contains harvestable shellfish). On a regional basis, only 36 percent of the coastal waters from New Hampshire through Boston Harbor are open, compared with 81 percent on the South Shore and 90 percent on Cape Cod (DMF statistics).

The Status of Massachusetts State Waters By Classification Type In Acres As of January 1, 1996



Prepared by Div. of Marine Fisheries. May 1, 1996 Acreage calculated by Mass/GIS. Conditional Approved (Contains both Seasonal and Rain Conditional Areas)

Over the past twenty-five years, the acreage of coastal waters open to shellfishing has gradually declined (Buchsbaum, 1992; Heufelder, 1988; Leonard *et al.*, 1989). Between 1970 and 1990, the closed acreage roughly tripled on the South Shore and increased about twenty-fold on Cape Cod. On a more positive note, however, hundreds of acres of shellfish beds in the region have been reopened since 1991, as a result of pollution abatement.

Studies in a number of areas around Massachusetts and Cape Cod Bays (Ipswich, the Annisquam River, Salem Sound, the North River-Scituate, and Cape Cod) show that the primary causes of closures of shellfish beds are inadequate sewage treatment systems, illegal sewer tie-ins to storm drains, stormwater runoff, and wastes from livestock, pets, and wild animals (Roach, 1992; Cooper and Buchsbaum, 1994; Heufelder, 1988). Most of the recent large increases in closures of shellfish growing waters in Massachusetts are attributed to increased development along the coast, resulting in increased nonpoint source pollution, and more intensive monitoring. Nonpoint source pollution of shellfish beds, particularly from stormwater, is often technically difficult to mitigate, since it requires the tracking of many small and diffuse sources, each of which may be polluting only intermittently. Creative land use planning and innovative engineering solutions are required to alleviate this problem and prevent future degradation. MBP is developing a model to help communities identify shellfish beds at risk of closure from future development (Horsley-Witten, in progress).

[Note: While most shellfish bed closures are due to pathogen contamination, certain biotoxins such as paralytic shellfish poisoning (PSP) periodically play a role in bed closures as well. PSP is a naturally-occurring seafood toxin that is caused by a tiny microorganism known as a dinoflagellate, *Alexandrium tamarense*. When the PSP-causing organism is present in large numbers, it is often referred to as "red tide." PSP can lead to serious health effects, and there is no known antidote. Shellfish that are harvested as part of a recreational or subsistence fishery appear to pose the greatest health risk because individuals may not be aware of a problem or do not heed the warnings. Coastal waters as well as the marketplace are monitored for indications of PSP by DMF and the Massachusetts Department of Public Health (DPH), respectively. This monitoring system appears to provide adequate public health protection.]

Closures of Swimming Beaches

Beaches are closed to swimming if fecal coliform counts exceed 200 cells per 100 ml seawater. Gastroenteritis is the most common disease that is contracted by swimming in contaminated waters. The Massachusetts Bays Program has calculated that about 10,000 swimmers annually may suffer illness as a result of incidental ingestion of marine waters. This translates to an annual risk of about one in a hundred. The beaches posing the greatest risks are primarily in the region extending both from Boston Harbor through Salem. These same beaches experience the greatest number of pollution-related closures.

A positive trend is the decrease in beach closures in Boston Harbor over the past few years. This has been attributed to chlorination of CSOs, repair of sewage interceptor conduits, and cessation of sludge discharges to the Harbor (Rex *et al.*, 1992).

Massachusetts Water Quality Standards

The Massachusetts Division of Water Pollution Control (DWPC), within the state Department of Environmental Protection (DEP), sets water quality standards and designated uses for specific coastal and inland waters. These are goals, and are based on an assessment of what a particular body of water should be able to achieve, both in terms of water quality and for shellfishing, fishing, swimming, and sustenance of aquatic life. Coastal waters are classified as either "SA," waters with the highest expected uses, or "SB," areas which cannot meet SA standards. The DWPC, through its biennial water quality assessment reports (under s.305(b) of the Clean Water Act) to EPA, periodically assesses how well water bodies are achieving their targeted goals and designated uses.

About 60 percent of Massachusetts marine and estuarine waters assessed by the DWPC do not support their designated uses due to pollution. Another 30 percent support their uses and 10 percent are in partial compliance. Designated uses, such as shellfish harvesting, were achieved for only 58 percent of the waters classified as SA, and for only one percent of those classified as SB. The parameter most frequently causing non-attainment is fecal coliform bacteria. Stormwater, CSOs, and municipal point source discharges are the major sources of non-attainment. Toxic contaminants and organic enrichment often prevent waterbodies from achieving their designated uses for maintenance of aquatic life and fishing. These observations provide strong support for the MBP's priority goals of reducing pathogen contamination of shellfish beds and reducing toxic pollution from stormwater runoff. MBP-funded studies which have contributed to our understanding of the sources and loadings of pollutants entering the Bays include Menzie-Cura (1991), Menzie-Cura (1995a and 1995b), Golomb *et al.* (1995), and Zemba (1995).

Conclusion

Characterizing the status of the physical and biological resources of the Bays, as well as the sources, loadings, fate and effects of pollutants, serves as an essential first step in developing a sound comprehensive management plan. The recommendations in this CCMP have evolved from our understanding of the state of the Bays, coupled with the practical wisdom and experience of concerned citizens and agency professionals working together over the past five years.

[An expanded State of the Bays report is in preparation and will serve as a companion document to the CCMP.]

III

Overview of Coastal Subregions

Chapter III of the CCMP provides background information on each of the five coastal subregions that comprise the larger Massachusetts Bays region. These five subregions and the communities they include are shown below. Each of the subregions is described in terms of its major physical characteristics, population and economy, land use, water quality (including municipal sewage and sludge treatment methods, shellfish resources, public beaches, and other commercial and recreational uses. Information also is given on selected resource management issues important to each region - for example, rapid population growth, closure of contaminated shellfish beds, or coastline erosion. Major coastal improvement projects and activities, such as the MBP Mini-Bays projects, stormwater remediation activities, and harbor management planning, also are described. Finally, an extensive directory is given of regionally-important projects and programs, key contact persons, and sources of financial and technical assistance to the Bays' 49 coastal communities. Excerpts from the CCMP for each of these regions are available upon request from the Massachusetts Bays Program Office.

Upper North Shore Region

Salisbury
Newburyport
Newbury
Rowley
Ipswich
Essex
Gloucester
Rockport

Salem Sound Region

Manchester-by-the-Sea
Beverly
Danvers
Peabody
Salem
Marblehead

Metro Boston Region

Swampscott
Lynn
Nahant
Saugus
Revere
Everett
Chelsea
Winthrop
Boston
Milton
Quincy
Braintree

South Shore Region

Plymouth
Kingston
Duxbury
Marshfield
Norwell
Pembroke
Hanover
Scituate
Cohasset
Hull
Hingham
Weymouth

Cape Cod Region

Provincetown
Truro
Wellfleet
Eastham
Orleans
Brewster
Dennis
Yarmouth
Barnstable
Sandwich
Bourne

IV

Projects of Regional Scope and Impact

Introduction

Chapter IV of the CCMP describes a number of large, ongoing or proposed projects in the Massachusetts Bays region that are expected to have a greater-than-local impact on the water quality, coastal habitat, and living marine resources of the Bays ecosystem. These projects of regional significance (so-called "megaprojects") include:

- Boston Harbor Project: Upgrading Sewage Treatment in the Metro Boston Area
- Central Artery/Third Harbor Tunnel Project
- Boston Harbor Navigation Improvement Project
- Massachusetts Bay Disposal Site
- South Essex Sewerage District Project
- Saugus River Flood Control Project
- Plymouth Sewage Treatment Project

The MBP believes that such expensive and complicated projects should be held to the highest standards of public review. The process of reviewing these projects in the CCMP is intended to identify and illuminate issues of environmental concern and to recommend actions which should be taken to ensure that each of the projects proceeds in a manner that maximizes benefits for the people of the region while posing the least risk to the coastal environment.

Boston Harbor Project: Upgrading Sewage Treatment in the Metro Boston Area

One of the biggest public works projects ever undertaken in New England, the Boston Harbor Project involves the rehabilitation of the Metro Boston region's ailing water and sewer systems and the construction of new wastewater and sludge treatment facilities. Key components of the project include:

- wastewater collection and delivery system improvements;
- combined sewer overflow (CSO) reduction and treatment initiatives;
- new wastewater screening headworks;
- new primary and secondary wastewater treatment facilities;
- new effluent conveyance/diffuser facilities;
- new sludge-to-fertilizer facility; and
- a toxics reduction and control program.

These improvements are expected to make Boston Harbor and its tributaries much cleaner than they have been in more than a century. Indeed, the activities to date have already resulted in a demonstrably cleaner Boston Harbor. Nevertheless, the project has not been without controversy. Despite study findings and agency determinations to the contrary, concern has been raised by some about potential water quality and ecological impacts associated with relocating the treated wastewater discharge from Boston Harbor to a site 9.5 miles out in Massachusetts Bay. This concern centers around possible nutrient over-enrichment of Bays waters and potential resultant algal blooms and depleted oxygen conditions that could pose a threat to marine life. To address this concern, an Outfall Monitoring Task Force has been assembled to monitor scientific data from the site and to suggest remedial action should any adverse impacts occur.

The CCMP recommends the following actions in order to ensure that the project proceeds in a manner that both maximizes benefits for the people of the region and poses the least risk to the marine ecosystem.

Recommended Actions

The Massachusetts Water Resources Authority (MWRA) should:

- *plan its operating budget to ensure sufficient funds are available for operation and maintenance of the new treatment facilities (this budget parameter is a requirement for the receipt of federal funding);*
- *continue aggressive enforcement of industrial permits;*
- *continue efforts to reduce household hazardous waste*

and to educate the public about proper use of the sewer system;

- *eliminate CSOs where deemed appropriate by a public review process;*

- *continue maintaining the sewer system;*

- *monitor the health of the ecological community by assessing species abundance and diversity of the benthos in Stellwagen Basin and Cape Cod Bay near the outfall; and*

- *implement contingency planning, with public input, based on meaningful and verifiable triggers.*

Communities and citizen organizations have taken an active role in reviewing and commenting on the March 1995 Draft Contingency Plan. The Coastal Advocacy Network and others have recommended that, should unforeseen circumstances seriously threaten the health of the Bays, the contingency planning process should give consideration to all contingency options, including advanced levels of treatment (e.g., effluent filtration, organic polymer addition, etc.) and inshore diversion of effluent. Several communities have expressed the concern that contingency planning should protect the health of Boston Harbor, as it continues to recover from the effects of past effluent discharges. *The Massachusetts Bays Program recommends that the MWRA should:*

- *consider all contingency planning options, and, consistent with the goals of this CCMP, the MWRA should strive to protect all of our shared coastal resources, from the North Shore to Boston Harbor to Cape Cod Bay; and*

- *continue to make all monitoring data available to interested parties in a mutually-agreed upon and timely fashion.*

The 43 MWRA customer communities should:

- *minimize infiltration and inflow;*

- *implement strong stormwater management measures aimed at achieving the water quality standards in Boston Harbor and its tributaries; and*

- *maintain their portions of the sewer system.*

The Outfall Monitoring Task Force should:

- *Adopt meaningful change values for several environmental indicators, including, but not necessarily limited to:*
  1. *percent change in liver lesions of winter flounder;*
  2. *exceedences of water quality standards;*
  3. *exceedences of FDA limits for seafood safety; and*
  4. *changes in dissolved oxygen for Stellwagen Basin.*

- *Recommend meaningful changes for:*
  1. *biological productivity; and*
  2. *structure of the benthic community, particularly as it relates to contaminant levels in marine sediments.*

- *Ensure that MWRA monitoring efforts are coordinated with the state's planned monitoring program and the nationwide marine monitoring programs.*

The U.S. Environmental Protection Agency (EPA) should:

- *in collaboration with DEP, ensure MWRA compliance with its discharge permit when the permit is finalized and becomes effective; and*

- *continue to collaborate with MWRA and NMFS on the Memorandum of Understanding (MOU) to implement the conservation recommendations in the NOAA Biological Opinion.*

The National Marine Fisheries Service (NMFS) should:

- *immediately implement the Recovery Plans for the North Atlantic Right Whale and Humpback Whale; and*

- *continue to collaborate with MWRA and NMFS on the Memorandum of Understanding (MOU) to implement the conservation recommendations in the NOAA Biological Opinion.*

The National Oceanic and Atmospheric Administration (NOAA) should:

- *continue to upgrade modeling techniques and pursue acoustical methods for the monitoring of outfall-generated plumes.*

The Department of Environmental Protection (DEP) should:

- *in collaboration with EPA, ensure MWRA compliance with its discharge permit when the permit is finalized and becomes effective.*

Central Artery/Third Harbor Tunnel Project

This huge construction project is designed to increase the capacity and safety of the Boston-area interstate highway system, improve access to Logan Airport and the South Boston seaport, and reduce traffic congestion in downtown Boston. Key components of the project include:

- a widened, mostly underground I-93 (Central Artery) from Charlestown to just south of the Massachusetts Avenue interchange, with 8 traffic lanes plus intermittent auxiliary lanes;

- an I-90 (Massachusetts Turnpike) extension via a Seaport Access Highway and Third Harbor Tunnel to Logan Airport in East Boston, with a connection to Route 1A. The new harbor tunnel will extend from the Subaru terminal in South Boston to Bird Island Flats in East Boston (The new harbor tunnel was opened December 15, 1995 and dedicated as the "Ted Willliams Tunnel.");

- an extended frontage road system parallel to I-93, both northbound and southbound, from Causeway Street to just past Southampton Street; and

- a South Boston bypass road to connect I-93 to the Seaport Access Highway and the Commonwealth Flats area of South Boston.

In addition to improving traffic flow and safety, the project is expected to have a number of environmental benefits, including:

- improvements in air quality resulting from fewer traffic snarls;

- increased parkland and open space in downtown Boston, along the Charles River, and on Spectacle Island;

- a cap to prevent leaching from the existing landfill on Spectacle Island; and

- restoration of 14 acres of coastal wetland at Rumney Marsh.

Despite these benefits, concern has been expressed by the City of Boston Conservation Commission and others over the project's potential impacts on water quality in Boston Harbor. Incidents of sediment control breakdown at Spectacle Island have been reported, with resultant plumes of suspended sediment observed in the waters around the island. It is important that effective stormwater runoff best management practices be instituted and maintained around the perimeter of Spectacle Island to prevent any further erosion and sedimentation from the island's construction and excavate fill sites.

Recommended Actions

The MBP has not developed recommendations specific to the Central Artery project at this time. However, the MBP will continue to track the nature and progress of the project, and will issue future recommendations as deemed appropriate.

Boston Harbor Navigation Improvement Project

This project involves the deepening of channels in several major Boston Harbor tributaries to permit the safe and efficient passage and berthing of container ships and tankers. These channels and many of their berths are currently too shallow to accommodate commercial shipping except during high tides, resulting in costly delays and limits on vessel size and loading. Areas to be deepened include:

- Reserved Channel. Most of the existing 35-foot channel would be deepened to 40 feet, including a portion of the main ship channel to provide a deep-water turning area.

- Mystic River. A major portion of the existing 35-foot channel would be deepened to 40 feet, except for areas along the south side and at the upstream limit where 40-foot depths are not required.

- Chelsea River. The existing 35-foot channel would be deepened to 38 feet after the relocation and alteration of utility crossings beneath the channel.

- Inner Confluence Area. The 35-foot confluence of the Mystic and Chelsea Rivers along the East Boston waterfront would be deepened to provide a safe 40-foot approach to the Mystic River and Chelsea River.

- Berth dredging. Berths that would economically benefit from channel dredging would be deepened, including berths on the Main Ship Channel.

Although the project is expected to result in major trade-related benefits for the Port of Boston and region, it has raised several important environmental concerns. These relate primarily to the potential impacts of channel dredging and disposal of dredged materials on marine water quality, living resources, and habitat. Some of the material to be dredged is contaminated and could harm aquatic life if not removed or disposed of in an environmentally-responsible

manner. The current "preferred" disposal option is "in-channel," with capping with clean materials to reduce the risk of significant environmental harm.

The CCMP recommends the following actions in order to ensure that the project proceeds in a manner that both maximizes benefits for the people of the region and poses the least risk to the marine ecosystem.

Recommended Actions

The Army Corps of Engineers (ACOE) should:

- *ensure adequate monitoring of the cap after completion of construction; and*

- *ensure that appropriate environmental performance standards are incorporated into construction contracts.*

Massport, ACOE, EPA, NMFS, and the Massachusetts Executive Office of Environmental Affairs (EOEA) should:

- *begin planning now for disposal of contaminated maintenance material, and explore range of applicable alternative technologies; and*

- *ensure adequate independent monitoring of all dredge and disposal work during construction.*

Massachusetts Bay Disposal Site

This "project" involved the formal designation of the Massachusetts Bay Disposal Site (MBDS) as a disposal site for uncontaminated sediments to be dredged from the Commonwealth's harbors and shipping channels. Over the next century, an estimated 23 million cubic yards of sediment will be generated from various dredging projects along the coast of Massachusetts Bay. EPA and the Army Corps of Engineers (ACOE) have determined that available upland disposal sites are not sufficient to meet these disposal needs, and have reaffirmed the need for an ocean disposal site.

The MBDS is an open water disposal site located roughly 21 nautical miles from Boston and 15 nautical miles from Gloucester, in waters ranging from 275 - 300 feet deep. Situated slightly southwest of a former disposal site used since the 1940s, this site was favored because it:

- preserves the relatively pristine condition of the eastern portion of the former MBDS;

- increases the distance between the disposal site and the National Marine Sanctuary at Stellwagen Bank;

- provides an opportunity to cover previously disposed contaminated sediments; and

- avoids an area of the Industrial Waste Site (IWS) that contains a high concentration of drums.

In August 1993, EPA issued a "Final Rule" which formally designated the MBDS as a disposal site for uncontaminated dredged sediments. Disposal was specifically limited to material which meets the requirements of the Marine Protection, Research, and Sanctuaries Act and its accompanying regulations. These requirements consider impacts to the marine environment, aquatic life, and human health. The Final Rule also prohibited disposal-and-capping of materials too contaminated for unconfined ocean disposal at the MBDS until its efficacy can be effectively demonstrated and it is authorized by law.

EPA's designation of the MBDS was not an authorization for the disposal of any particular dredged material at the site. Final site designation simply allows the MBDS to be considered as a disposal option when land-based alternatives are not practicable. Since only the actual disposal of dredged material, as authorized by EPA and the ACOE, directly affects Massachusetts Bay, the designation, by itself, will have no impact on the water quality or marine ecology of the Bays.

The Massachusetts Coastal Zone Management Office (CZM) will formally review any activity at the MBDS or modification of site restrictions which may be proposed in the future for consistency with its own policies. Projects also will be reviewed by NOAA, under the Sanctuary Consultation provision of the National Marine Sanctuaries Act (to insure that the activity will not adversely affect the resources or qualities of the Sanctuary) as well as under Section 7 of the Endangered Species Act (for protected species issues).

Nevertheless, concern has been expressed about the adequacy of future monitoring at the MBDS, as specific components of a long-term monitoring program for the MBDS are still to be determined. The EPA expects to develop long-term management plans for all of its open water disposal sites, including the MBDS, by January 1997.

The CCMP recommends the following actions in order to ensure that the project proceeds in a manner that both maximizes benefits for the people of the region and poses the least risk to the marine ecosystem.

Recommended Actions

EPA, ACOE, and CZM, in consultation with other appropriate federal and state agencies, should:

- *lead an interagency study group to define parameters for a demonstration study which could determine whether containment of contaminated sediments (e.g., capping) is a viable disposal option for the MBDS.*

EPA and NOAA should:

- *complete the interagency comprehensive assessment report on the IWS, giving particular attention to the site's potential impact on water quality and marine habitat in the MBDS area.*

South Essex Sewerage District (SESD) Project

This project involves the construction of a new secondary wastewater treatment plant by the SESD, a wastewater management authority which serves the Salem Sound communities of Salem, Beverly, Marblehead, Danvers, and Peabody. The new plant is being built alongside the District's existing but outmoded primary treatment facilities at Cat Cove in Salem.

The project is expected to result in water quality improvements which will enhance recreational and commercial uses of Salem Sound and improve the health of the marine ecosystem.

Nevertheless, concern has been expressed over the high cost of the project to ratepayers. (Water and sewer users in the five SESD communities will bear most of this cost, and can reasonably expect their bills to triple over 1990 levels by the time the project is completed in 1997).

In order to both maximize the SESD's beneficial impacts on Salem Sound and minimize the financial burden on ratepayers, the CCMP recommends the following actions:

Recommended Actions

All stakeholders in the project, including the SESD, DEP, and participating municipalities, should:

- *promote source reduction as a means of reducing contaminant loadings into Salem Sound;*
- *promote water conservation; and*
- *continue to seek state and federal funds to ease rate increases.*

Saugus River Flood Control Project

This project is intended to eliminate or reduce the storm-induced tidal surges that periodically inundate the 4,000-acre Saugus and Pines River floodplain and force the evacuation of homes and businesses. (The worst of these surges, occurring during the Blizzard of '78, damaged more than 3,000 homes and businesses and forced the evacuation of some 4,000 people.) The U.S. Army Corps of Engineers (ACOE) estimates that a storm of the same magnitude today would cause approximately $130 million of property damage.

As originally proposed by the ACOE, the project would consist of more than three miles of dikes, walls, and sand dunes along the coast. Its principal feature would be a series of protective floodgates across the mouth of the Saugus River. These floodgates would remain open most of the time, but would be closed during severe storms to prevent tidal surges from spilling into the floodplain.

The project has not yet moved beyond the design phase, as the Executive Office of Environmental Affairs believes that a mix of non-structural flood protection measures may be more cost-effective than the ACOE proposal, and has requested that these be further investigated. These non-structural measures include:

- maintenance and repair of existing dikes, seawalls, and tidal gates;
- retrofitting or elevating the most floodprone structures;
- dike construction;
- wetland acquisition;
- dune restoration;
- a floodplain management plan;

- infrastructure retrofit; and

- an early flood warning system.

Studies to determine the cost-effectiveness of the non-structural approach have been completed and reviewed by the ACOE. EOEA is not expected to make a decision on the Saugus River Flood Control Project until it has completed its analysis of the ACOE's technical findings regarding the state's plan and the impacts of current federal budgetary policies.

While the project is being reviewed in greater detail, the CCMP recommends the following actions:

Recommended Actions

Coastal communities should:

- *strictly enforce municipal ordinances, including zoning ordinances and the Massachusetts Wetlands Protection Act, which regulate development in flood-prone areas.*

Coastal communities and DEM should:

- *strengthen existing flood protection regulations as appropriate.*

EOEA should:

- *support efforts to preserve flood storage in the Saugus and Pines River Estuary and investigate a possible alliance with current efforts to restore wetlands;*

- *discourage development in flood hazard areas and pursue a nonstructural program of flood damage mitigation wherever feasible; and*

- *provide technical resources and enforcement assistance to communities seeking to tighten enforcement of municipal flood protection ordinances.*

Plymouth Sewage Treatment Project

This project will likely involve the construction of a new 3.0 million gallon per day (mgd) secondary treatment facility, along with possible alternative (decentralized) technologies, to alleviate the Town of Plymouth's mounting sewage management problems. During the 1970s and 1980s, Plymouth experienced explosive population growth that has resulted in huge wastewater volume increases. Unable to handle these increases, the existing treatment plant consistently violates the terms of its discharge permit and is a steady source of pollutants to Plymouth Harbor.

Under the terms of a 1992 Consent Decree, the town has been required to conduct a multi-phased Wastewater Treatment Facilities Plan and Environmental Impact Report (FP/EIR) to evaluate feasible management strategies. This report must assess the town's need for additional treatment capacity and determine the type of facilities that will best meet that need. Recently completed in draft form, Phase IIIA of the FP/EIR recommends, among other things, the construction of a new 3.0 mgd sewage treatment plant. However, it has not been determined how far the sewer service area for this plant will extend, nor how and where the treated effluent will be disposed.

Complicating the issue is the fact that more than 70 percent of Plymouth's residents currently rely on subsurface sewage systems to dispose of their wastewater. Although the town has already adopted several local supplements to Title 5, at least half of these on-site systems were installed prior to the promulgation of Title 5, and therefore do not meet the state's minimum siting or performance standards. As a result, on-site systems are contributing to water quality problems in Plymouth's groundwater, surface water bodies, and nearshore marine waters. Even if the proposed sewage treatment plant and sewer service area expansions are implemented, more than 60 percent of the town's residents will continue to rely on on-site systems in the year 2018. Therefore, a long-term septage management program must be an essential component of Plymouth's wastewater planning.

In order to ensure that an effective wastewater management plan is developed and implemented townwide, the CCMP recommends the following actions:

The Town of Plymouth should:

- *clearly identify on, a site-specific basis, the specific public health and/or environmental threats caused by on-site wastewater disposal, and direct its consultants to evaluate potential alternatives to central sewering for each of these areas, including community systems, alternative on-site technologies, system upgrades to Title 5, and inspection and maintenance programs; and*

- *explore alternatives to sewering the Industrial Park.*

The DEP should:

- *encourage Plymouth and other communities, as well as consulting engineering firms, to explore and use alternative and decentralized wastewater treatment and management technologies wherever feasible; and*

- *aggressively enforce water conservation standards established by the Water Resources Commission (October 1992) to help reduce wastewater flows and the need for additional wastewater treatment and management facilities.*

V

Action Plans

Chapter V is the centerpiece of the Massachusetts Bays Comprehensive Conservation and Management Plan. It contains 15 major action plans, the successful implementation of which is expected to lead to the restoration and protection of the Bays' water quality, living resources, and fish, shellfish, and wildlife habitat.

While some of the plans' prescribed actions are mitigative in nature, overall the emphasis is on prevention, in recognition of the simple truth that it will cost far more to clean up pollution later than to prevent it now. The plans also are based on a premise of shared responsibility among all of us in the Massachusetts Bays region who use and enjoy the Bays' bountiful resources. Recognizing that fish, wildlife, water, and pollutants all cross jurisdictional lines, the plans establish a framework based on a partnership among government agencies (federal, state, regional, and local), nonprofit organizations, the private sector, and citizens.

Each major action plan in the CCMP contains a series of individual recommended actions, each of which is divided into eight sections: Rationale, Responsible Agent(s), Implementation Strategy, Legislation Required, Estimated Cost, Potential Funding Source(s), Target Date, and Further Information. These sections document the need for each action and describe the organizations, strategies, and timetables recommended for implementing them. Estimated costs and potential funding sources are identified as well. For more extensive information on funding opportunities, the reader is referred to both Chapter VII and the MBP report entitled, *Financing the Massachusetts Bays CCMP: Federal, State, and Local Funding Sources and Mechanisms* (December 1994).

A matrix of the 15 major action plans and individual recommended actions follows. Each of the CCMP Action Plan sections is available in full on request from the Massachusetts Bays Program office.

The 15 major action plans in the CCMP are listed as follows:

CCMP Action Plans

1. **Protect Public Health**
2. **Protecting and Enhancing Shellfish Resources**
3. **Protecting and Enhancing Coastal Habitat**
4. **Reducing and Preventing Stormwater Pollution**
5. **Reducing and Preventing Toxic Pollution**
6. **Reducing and Preventing Toxic Pollution**
7. **Managing Municipal Wastewater**
8. **Managing Boat Wastes and Marina Pollution**
9. **Managing Dredging and Dredged Materials Disposal**
10. **Reducing Beach Debris and Marine Floatables**
11. **Protecting Nitrogen-Sensitive Embayments**
12. **Enhancing Public Access and the Working Waterfront**
13. **Planning for a Shifting Shoreline**
14. **Managing Local Land Use and Growth**
15. **Enhancing Public Education and Participaion**

SUMMARY OF RECOMMENDED ACTIONS

Responsible Agency	ACTION PLAN #1 Protecting Public Health	ACTION PLAN #2 Protecting and Enhancing Shellfish Resources
Department of Public Health (DPH)	**1.1** Establish a central clearinghouse program for all beach testing and closure information generated for Massachusetts' coastal public beaches.	
Division of Marine Fisheries (DMF)		**2.1** Conduct three (3) *Sanitary Survey Training Sessions* annually -- one each on the North Shore, Metro Boston/South Shore, and Cape Cod -- to educate local shellfish constables and health officers on the proper techniques for identifying and evaluating pathogen inputs into shellfish harvesting areas. **2.2** Develop and administer a local *Shellfish Management Grants Program* to help communities finance the development and implementation of effective local shellfish management plans.
Shellfish Bed Restoration Program (SBRP)		**2.3** Continue and expand the innovative *Shellfish Bed Restoration Program* to restore and protect shellfish beds impacted by nonpoint source pollution.

SUMMARY OF RECOMMENDED ACTIONS

Responsible Agency	ACTION PLAN #3 Protecting and Enhancing Coastal Habitat
Municipalities	**3.1** Prepare and implement an EOEA - approved *Open Space Plan* to preserve and protect key wetlands, floodplains, fish and wildlife habitat, and other ecologically- and recreationally-important natural resource areas. **3.2** Adopt and implement a local *Riverfront District Bylaw* to maintain river water quality, preserve fish and wildlife habitat, and protect downstream nursery and shellfish resources. **3.3** Work cooperatively with neighboring communities, EOEA agencies, and other interested parties to develop proactive, long-term *ACEC Management Plans* to preserve and protect these vital resource areas. **3.4** Adopt and implement a local *Wetlands Protection Bylaw* to supplement the state Wetlands Protection Act Regulations. **3.5** Prepare and implement ecosystem-based *Barrier Beach Management Plans* to promote responsible use and protection of these critical coastal resources. **3.6** Employ full-time, professionally-trained conservation staff to provide ongoing technical and administrative support to local Conservation Commissions.
Department of Environmental Management (DEM)	**3.7** Develop and implement *Resource Management Plans* for all DEM-owned coastal properties. **3.8** Develop and promote the use of river basin planning reports to facilitate responsible water resources planning and management at the local and regional levels. **3.9** Acquire and restore undeveloped coastal properties that offer outstanding living resources habitat and public recreation opportunities.
Department of Environmental Protection (DEP)	**3.10** Complete the statewide inventorying and mapping of coastal and inland wetlands, and provide local Conservation Commissions with: 1) accurate base maps depicting wetland boundaries, and 2) instruction on proper wetland map interpretation and use.
Department of Fisheries, Wildlife and Environmental Law Enforcement (DFWELE)	**3.11** In collaboration with the Riverways Program, prepare an up-to-date inventory of anadromous fish runs in the Massachusetts Bays region and develop a strategy to prioritize, restore, and maintain these runs. **3.12** In collaboration with the Riverways Program, develop and implement a citizen-based *Fishway Stewardship Program* to restore and maintain anadromous fish runs along the Massachusetts Bays coast.
Executive Office of Environmental Affairs (EOEA)	**3.13** Continue the innovative *Wetlands Restoration and Banking Program* to restore and protect degraded coastal and inland wetlands.
Environmental Protection Agency (EPA), National Marine Fisheries Service (NMFS), and U.S. Army Corps of Engineers (ACOE)	**3.14** Continue and expand current efforts to support eelgrass habitat protection and restoration in Massachusetts and Cape Cod Bays.

SUMMARY OF RECOMMENDED ACTIONS

Responsible Agency	ACTION PLAN #4 Reducing and Preventing Stormwater Pollution
Municipalities	**4.1** Adopt subdivision regulations that require the incorporation of stormwater runoff best management practices (BMPs) into all new development plans. **4.2** Implement best management practices to mitigate existing stormwater discharges that are causing or contributing to the closure of shellfish harvesting areas and swimming beaches.
Department of Environmental Protection (DEP)	**4.3** In collaboration with Regional Planning Agencies, Natural Resources Conservation Service/MassCAP (formerly U.S. Soil Conservation Service), and Massachusetts Coastal Zone Management Office, 1) disseminate the *Nonpoint Source Management Manual* and *Urban Best Management Practices for Massachusetts,* and 2) sponsor public workshops to educate local officials about best management practices and performance standards for controlling stormwater runoff. **4.4** Develop a coordinated and streamlined regulatory system within DEP to assure effective implementation of the stormwater components of the Massachusetts Clean Water Act, Wetlands Protection Act, and Federal Stormwater Program (Federal Clean Water Act, Sections 401 and 402).
Environmental Protection Agency (EPA)	**4.5** Reduce stormwater pollution in the Massachusetts Bays watersheds through: (a) technical assistance to communities in developing comprehensive stormwater management programs; and (b) National Pollutant Discharge Elimination System (NPDES) compliance for industrial stormwater dischargers. Targeted areas are the lower Charles River for the stormwater management programs and the Neponset River for the industrial stormwater dischargers.
Massachusetts Highway Department (MHD)	**4.6** Prepare an *Environmental Manual* to complement the *Highway Design Manual* and provide for the integration of environmental concerns (including stormwater management) into all phases of highway project planning, design, construction, and maintenance. **4.7** As part of its forthcoming pollution prevention plan, develop a *Stormwater Pollution Mitigation Program* to identify, prioritize, and correct existing stormwater pollution problems associated with state highway drainage facilities. **4.8** Sponsor annual workshops to train local public works personnel on the proper use of stormwater runoff best management practices.
Massachusetts Highway Department (MHD) and Metropolitan District Commission (MDC)	**4.9** Require the use of on-site stormwater best management practices as a precondition to the permitting of private property tie-ins to state drainage facilities.

SUMMARY OF RECOMMENDED ACTIONS

Responsible Agency	ACTION PLAN #5 Reducing and preventing Toxic Pollution	ACTION PLAN #6 Reducing and Preventing Oil Pollution
Municipalities	**5.1** Adopt and implement the following set of regulations to ensure the safe use, storage, and disposal of toxic and hazardous materials: 1) *Toxic and Hazardous Materials Regulation*, 2) *Underground Storage Tank Regulation*, and 3) *Commercial/Industrial Floor Drain Regulation*. **5.2** Establish *Household Hazardous Waste Collection Programs* for difficult-to-manage hazardous products to ensure their proper disposal on a regular basis.	**6.1** Establish and promote the use of *Used Motor Oil Collection Facilities* to ensure the proper collection and disposal of used motor oil from do-it-yourself oil changes.
Department of Education (DOE)	**5.3** In collaboration with the Department of Environmental Protection, develop and offer continuing education courses on hazardous materials management to create a pool of trained "HazMat Specialists" at the local level.	
Department of Environmental Protection (DEP)		**6.2** In collaboration with the U.S. Coast Guard, EPA, and NOAA, implement the *Policy on the Use of Oil Spill Chemical Countermeasures (Dispersants)* to protect coastal resources from the adverse effects of oil spills.
Executive Office of Environmental Affairs, Municipalities, & Private Sector Partnership	**5.4** Form partnerships to facilitate the safe management of hazardous products, emphasizing reduced products use and recycling wherever possible.	
Environmental Protection Agency (EPA)	**5.5** Reduce and prevent toxic pollution through targeted National Pollutant Discharge Elimination System (NPDES) permitting of significant discharges in the Massachusetts Bays; in particular, oil tank farms on Chelsea Creek and the Island End River.	
EOEA Office of Technical Assistance for Toxics Use Reduction (OTA)	**5.6** Continue to perform on-site assessments and provide instructional materials to help businesses and industries in the Massachusetts Bays region reduce the use of toxic substances.	
US Coast Guard (USCG)		**6.3** In collaboration with other federal, state, and local agencies, continue to update and implement the Massachusetts coastwide *Area Contingency Plans* to assure a rapid and effective response to discharges of oil and other hazardous substances into the marine environment.

SUMMARY OF RECOMMENDED ACTIONS

Responsible Agency	ACTION PLAN #7 - Managing Municipal Wastewater		
	7A. Managing Centralized Wastewater Treatment Facilities	**7B. Managing On-Site Sewage Disposal Systems**	**7C. Decentralized Wastewater Management and Treatment**
Municipalities		**7B.1** Identify resource areas sensitive to wastewater and develop management plans appropriate to these areas, focusing on the capacities of natural systems to assimilate wastewater. **7B.2** In cooperation with DEP, develop and implement regular inspection and maintenance (I/M) programs for on-site wastewater systems. **7B.3** Employ full-time, professionally-trained public health staff to provide ongoing technical and administrative support to the local Boards of Health.	**Note:** Specific recommended actions for this Action Plan will be developed by the Massachusetts Bays Program and incorporated in future supplements to the CCMP.
Coastal Regional Planning Agencies		**7B.4** Establish a Title 5 and alternative systems technical assistance program directed to local Boards of Health and health agents, systems engineers / installers, and homeowners.	
Department of Environmental Management (DEM)	**7A.1** In collaboration with other state and federal agencies, continue to implement the Ocean Sanctuaries Act by closely monitoring all facilities plans which propose increased waste-water treatment plant discharges into an ocean sanctuary.		
Department of Environmental Protection		**7B.5** Evaluate and build upon the centralized statewide repository for testing information on alternative tech-nologies, to be established as part of the Buzzards Bay Project's two-year Environmental Technology Initiative Project.	
Environmental Protection Agency (EPA)	**7A.2** Support the control of combined sewer overflows in the Massachusetts Bays watersheds, especially the lower Charles River, and target National Pollutant Discharge Elimination Systems (NPDES) permitting to implement technology- and water quality-based requirements in the Merrimack River watershed.		
Environmental Protection Agency, Exec. Office of Environmental Affairs, Dept of Environmental Protection, and Coastal Zone Management Office	**7A.3** Work collaboratively to develop and implement an effective program for monitoring and enforcing point source discharges from wastewater treatment plants and energy-producing facilities.		

SUMMARY OF RECOMMENDED ACTIONS

Responsible Agency	ACTION PLAN #8 Managing Boat Wastes and Marina Pollution	ACTION PLAN #9 Managing Dredging and Dredged Materials Disposal	ACTION PLAN #10 Reducing Beach Debris and Marine Floatables	ACTION PLAN #11 Protecting Nitrogen-Sensitive Embayments
Municipalities	**8.1** Work cooperatively with neighboring communities, private boatyards and marinas, and state agencies (DFWELE and CZM) to establish, promote, and maintain *Boat Pumpout Programs* in targeted embayment areas. **8.2** With assistance from CZM and DEP, require private boatyards and marinas to implement effective storm-water runoff control strategies which include the use of pollution prevention measures and the proper design and maintenance of hull servicing areas.		**10.1** Work cooperatively with the Massachusetts Coastal Zone Management Office, neighboring communities, and waterfront users to design and implement *Beach and Marine Debris Reduction Programs*.	
Army Corps of Engineers (ACOE)		**9.1** Continue to monitor dredged material disposal sites in the Massachusetts Bays region and initiate the planning necessary to begin a capping demonstration project at the Massachusetts Bay Disposal Site.		
Department of Environmental Protection (DEP)				**11.1** Strengthen *Massachusetts Water Quality Standards* to enhance and protect nitrogen-sensitive coastal embayments.
Executive Office of Environmental Affairs (EOEA)		**9.2** Coordinate the development of a comprehensive *Dredging and Dredged Materials Disposal Plan* to improve and maintain access to the Commonwealth's ports, harbors, and channels, and to minimize adverse impacts to the marine environment.		
Regional Planning Agencies, Department of Environmental Protection, and Municipalities				**11.2** Work collaboratively to expand upon current Massachusetts Bays Program efforts to identify nitrogen-sensitive embayments, determine critical loading rates, and recommend actions to manage nitrogen so as to prevent or reduce excessive nitrogen loading to coastal waters and groundwater.

SUMMARY OF RECOMMENDED ACTIONS

Responsible Agency	ACTION PLAN #12 Enhancing Public Access and the Working Waterfront	ACTION PLAN #13 Planning for a Shifting Shoreline	ACTION PLAN #14 Managing Local Land Use and Growth
Municipalities	**12.1** Develop and implement *Municipal Harbor Plans* which: 1) promote marine-dependent waterfront uses, 2) enhance public access to the water, and 3) protect habitat of shellfish and other living resources.	**13.1** Adopt and implement strict development/ redevelopment standards within FEMA A and V flood hazard zones and other areas subject to coastal flooding, erosion, and relative sea level rise.	**14.1** Develop and implement *Local Comprehensive Plans* (LCPS) which: 1) direct development into areas in the community capable of absorbing the impacts of growth and its associated facilities, and 2) preserve and protect the community's important natural resources.
Coastal Zone Management Office (CZM)	**12.2** Enhance the Designated Port Area (DPA) program with new planning and promotional initiatives. **12.3** Establish a new technical assistance program to accelerate municipal efforts to identify and legally reclaim historic rights-of-way to the sea. **12.4** In collaboration with the Department of Environmental Management and MassGIS, prepare and distribute a statewide *Coastal Access Guide* to facilitate public access to the shoreline.		
Department of Environmental Management (DEM)		**13.2** Continue to assist communities in the development of effective *Floodplain Management Regulations*.	
Executive Office of Environmental Affairs (EOEA)	**12.5** In collaboration with coastal municipalities, develop and implement an *Access-Via-Trails* program to enhance public access along the coast.		

SUMMARY OF RECOMMENDED ACTIONS

	ACTION PLAN #15 Enhancing Public Education and Participation	
Responsible Agency	**15A. Educating Teachers, Students, and the Public About the Bays**	**15B. Developing a State Nonpoint Source Education and Outreach Strategy**
Department of Education (DOE)	**15A.1** In collaboration with the Executive Office of Environmental Affairs, continue to develop and integrate environmental education as an important component of the curriculum in the public schools of the Commonwealth, making broad use of the Benchmarks for Environmental Education developed by the Secretaries' Advisory Group on Education (SAGEE).	
Executive Office of Environmental Affairs (EOEA)	**15A.2** Continue to work closely with the Department of Education through the Secretaries' Advisory Group on Environmental Education (SAGEE) in order to develop a strategy for the implementation of the "Benchmarks for Environmental Education". Further, EOEA should continue to place a priority on the role of environmental education and provide adequate staffing to insure that appropriate state leadership is maintained. **15A.3** In cooperation with the Department of Education, continue to develop a grant relationship with the National Science Foundation and other funding agencies in order to provide technological outreach aimed at enhancing environmental literacy. The goal is to make resource and curriculum materials widely accessible and to provide ongoing coordination among the various members of the education community. The Massachusetts Bays Program represents an important aspect of the total environmental picture and should play a key role in this effort, helping to establish a unified voice to speak for environmental education concerning the Bays region.	**15B.1** Develop and maintain a clearinghouse of NPS education, information, and technical assistance materials, as well as a database of available state NPS materials and programs. **15B.2** Develop and maintain a matrix, by topic, of NPS education, information, and technical assistance materials produced by state agencies and associated organizations. **15B.3** Expand upon Massachusetts Bays Program efforts and develop a strategy for NPS outreach and technical assistance state-wide that would coordinate the development and production of NPS education, information, and technical assistance materials, and provide technical assistance in order to implement NPS pollution controls.
Exec. Office of Environmental Affairs (EOEA) and the Department of Education (DOE)	**15A.4** Empower exemplary teachers, administrators, and/or schools who demonstrate the competence to carry out formal and non-formal environmental education initiatives that complement the Commonwealth's environmental education programs.	
Massachusetts Bays Education Alliance (MBEA)	**15A.5** Continue and expand its current efforts to build a community of educators who can ably teach about and promote the protection of the Massachusetts Bays, their shores, and watersheds.	
Coastal Advocacy Net-work (CAN)	**15A.6** Continue to serve as a vehicle for bringing information to and from the government on environmental issues affecting the Bays, with a particular emphasis on proposed projects or regulatory changes.	
Massachusetts Bays Business and Users Group (BUG)	**15A.7** Continue to provide a public forum for the exchange of information and ideas on CCMP development and implementation among the Bays' business community and resource users.	
Marine Studies Consortium	**15A.8** Continue to offer undergraduate marine science and policy courses; and, through the bi-annual Massachusetts Marine Environment Symposium, bring together diverse marine interests to promote a better understanding of marine policy issues.	

VI

Implementing the CCMP

Introduction

The Massachusetts Bays area is an estuarine system in transition. Increased development along its shores and in upland watershed areas, coupled with decades of discharging municipal and industrial wastes into its waters, has placed the Bays ecosystem in jeopardy. Fortunately, it is not too late to reverse the trend of declining water quality and to restore the Bays. Indeed, there are positive signs that this has already begun to occur in places, most notably Boston Harbor.

The action plans presented in Chapter V articulate a number of recommended steps that should be taken now and in the future to restore and protect the Massachusetts Bays ecosystem. The action plans also identify the organizations that are responsible for taking those steps. These organizations include regulatory and planning agencies at the federal, state, regional, and local levels; legislative bodies; business community representatives; and citizen groups.

For many of the recommendations, these organizations share overlapping responsibility, and close coordination will be required to ensure that proper actions are taken without duplication of effort or the wasting of limited resources. For other recommendations, a single organization can achieve the desired result. For still others, the implementing responsibility may belong to one organization, but another organization may be called upon to provide technical or financial assistance.

In working together to implement the CCMP, it will be important for all participants to view the Bays ecosystem as a regional resource to be shared and protected by many Massachusetts cities and towns (in all, 49 coastal communities and 112 inland communities). Achieving the Massachusetts Bays Program's principal goal - *the preservation and management of a healthy ecosystem of living resources, useable by the public* - will depend to a great extent on regionally-based implementation of the CCMP actions, while recognizing Massachusetts' strong home rule tradition and significant potential for environmental protection at the local level.

Regional Approach to Implementation

MBP's advocacy for a regional approach to CCMP implementation is based on three recent and highly successful models, described as follows:

- **Utilization of Regional Planning Agencies.**

The Commonwealth's Regional Planning Agencies (RPAs) have historically provided regionally-based technical and planning assistance to communities and watershed organizations. In particular, through RPAs, the MBP funds staff support to the five Local Governance Committees (LGCs) geographically located throughout the 49 coastal communities in the Massachusetts Bays area. Members of each of the LGCs are appointed by the chief elected officials of each community. LGC staff currently assist these communities with activities such as water quality monitoring, protective bylaw development, grantsmanship, and public education - all with the ultimate goal of helping to shape and implement CCMP actions. Using the geographical framework and expertise of the Commonwealth's RPAs, the LGCs have been successful in building local capacity to address coastal water quality issues through a combination of technical assistance, outreach/education, and implementation approaches.

- **Shellfish Bed Restoration Program.**

Shellfish beds which are closed to harvesting, either temporarily or permanently, are an indicator of declining water quality in the Massachusetts Bays and other marine waters. In October of 1993, an interagency team recognized that the actions needed to reopen these beds were not the sole responsibility of any one agency, as no one agency has all the necessary resources to address the problems. This team includes representatives of the MBP, Massachusetts Division of Marine Fisheries, Massachusetts Department of Environmental Protection, U.S.D.A. Natural Resources Conservation Service, County Conservation Districts, and municipalities with impacted shellfish beds. The MBP/RPA/LGC framework described previously is an integral part of the Shellfish Bed Restoration Program "team"

approach, providing the local technical assistance and community participation that is key to the program's success.

To date, the coordinated work of the Shellfish Bed Restoration Program (SBRP) team has resulted in the securing of grant funds for the identification of stormwater pollution sources and for mitigation of pollution problems at two of the 12 priority beds identified by the team. In addition, the SBRP is credited with the successful reopening of over 400 acres of shellfish beds. The team plans to seek additional funds to support remediation measures which could result in the reopening of additional shellfish beds. Lastly, this effort also includes a commitment to proactive education and outreach in order to insure measures which will keep currently usable, but threatened, beds open.

- **Participation in the State Watershed Initiative.**

The state Watershed Initiative builds upon the state's basin assessment schedule. For the purposes of assessing water quality and managing the state's water resources, the Massachusetts DEP conducts water quality assessment, planning, and implementation in the state's basins on a rotating five-year schedule. The Watershed Initiative expands this approach to create EOEA Basin Teams, made up of state and federal agency staff, who will perform watershed-wide water quality and habitat assessments for use by the Watershed Community Council in watershed planning. A pilot river basin (the Neponset) was selected in 1994 to explore and develop the coordinated river basin management approach. Within the Neponset Basin, local citizen/community sub-basin "stream teams" were developed to perform shoreline surveys and other local assessments and to help develop action plans for each segment of the river. The Massachusetts Bays Program assisted in the development of the estuarine sub-basin plan. The results of citizen efforts and the EOEA Basin Team for the Neponset are being combined to create a watershed management plan for the Neponset Basin.

The watershed management process, adapted from the Neponset model, is seen as consisting of a series of four steps, each building on the other and carried out in an ongoing fashion by the Watershed Community Council, Stream Teams, EOEA Basin Teams, municipal governments, and businesses. The steps are: outreach, education, and technical assistance; resource assessment; water resources planning; and plan implementation (including permitting, compliance, and enforcement). Through these steps, watershed stakeholders would collaborate in the identification of environmental problems, and in the development of Subwatershed Action Plans and Watershed Action Plans. The Action Plans would describe protection and restoration measures, assign responsibilities for these measures, and set forth a schedule for implementation.

A Regional Approach to CCMP Implementation: Future Efforts

This section describes the position of the Massachusetts Bays Program regarding regional implementation of the Comprehensive Conservation and Management Plan for the Bays, through consideration of current efforts and by listing recommendations for future efforts:

- The MBP believes that the MBP/RPA/LGC Technical Assistance Team model described in the previous section should be institutionalized to ensure future CCMP implementation. This cooperative and mutually beneficial relationship should be targeted for dedicated funding (refer to latter portions of this section) and legislative recognition.

- The interagency technical assistance team approach developed for the Shellfish Bed Restoration Program should be applied to other "teams" which will be created to implement various CCMP actions, such as those relating to stormwater management, toxics control, and protecting nutrient sensitive embayments.

- Further, the MBP believes that the MBP/RPA/LGC model and technical team approach should be extended into the Massachusetts Bays drainage area (i.e., outside the 49 coastal communities), in order to be comprehensive in its efforts to improve and manage coastal water quality on a watershed basis. This could be accomplished through coordination of the existing coastally-based Local Governance Committees with the multi-town planning committees which currently exist within the RPA geographic areas, serving the Bays' watershed communities. Since these multi-town committees are typically general purpose, they could enhance their productivity with a specific agenda of CCMP implementation activities or possibly serve as the "umbrella" for a CCMP-specific subcommittee within that multi-town planning committee.

- Finally, by organizing these committees around issues on a subwatershed/watershed basis, they could serve as a key component of the Massachusetts Watershed Initiative. This initiative involves coordinating the efforts of multiple state agencies, communities, and citizen organizations to improve water quality planning and management. The technical assistance component of the MBP/RPA/LGC model could also serve to support implementation of the state's Coastal Nonpoint Source Pollution Control Plan.

Funding and Implementation

- Dedicated funding for continuing and expanding the RPA/LGC and Watershed Initiative models into the Massachusetts Bays watershed can be obtained through sources which could include federal funds targeted to CCMP priorities in program guidances; state bond funds (e.g., the Open Space Bond); a small percentage of appropriate state agency operating budgets; the State Revolving Fund; the proposed Clean Water Act provision for watershed planning; the Intermodal Surface Transportation Efficiency Act, which links transportation improvements with water quality implementation; or through establishment of a non-profit organization.

- For proposed federal projects in the Bays' watershed which have the potential to impact the Bays, the Massachusetts Bays Program should request Federal Consistency procedures by the Massachusetts Coastal Zone Management Office, with comments to be provided by the Massachusetts Bays Program.

- The regional approach to CCMP implementation also should be utilized to assist with implementation of the Commonwealth's Coastal Nonpoint Source Pollution Control Plan (also known as the "6217" program). Under §6217 of the federal Coastal Zone Act Reauthorization Amendments, the Massachusetts CZM program is required to develop and implement a NPS Control Plan, which contains many of the same coastal water quality management and improvement measures as the CCMP (e.g., stormwater management). The guidance for development of the NPS Control Plan includes the requirement to develop enforceable measures for controlling nonpoint sources of pollution.

- The regional approach also should be used to support the development and implementation of watershed plans within the river basins which drain into the Bays, an approach strongly supported by EOEA and currently being piloted in the Neponset River Basin as part of the Massachusetts Watershed Initiative.

For purposes of assessing water quality and managing the state's water resources, the EOEA Basin Teams undertake water quality and habitat assessment, planning, and implementation in the state's major river basins on a rotating five-year schedule. As individual river basins in the Massachusetts Bays watershed go through the EOEA basin schedule, members of the MBP/RPA/LGC Technical Assistance Team will actively participate, providing ongoing support and guidance to Bays watershed communities. Initial steps to coordinate the coastal MBP/RPA/ LGC program with the EOEA basin teams are already underway.

Management Conference Structure and Role

- During the spring of 1996, the MBP Management Committee will begin to define in detail the post-CCMP processes which will be used to: review and update CCMP policy, goals, and objectives; approve annual workplans; and guide and closely monitor implementation, including the progress of the cooperative MBP/RPA/LGC Technical Assistance Teams.

- As a result of a Bays-wide retreat held in January, 1996, the LGCs have already affirmed their commitment to continue to serve as liaison between the communities and the Massachusetts Bays Program, initiating, prioritizing, and facilitating CCMP implementation actions at the local and regional levels. Specific LGC workplans defining implementation and monitoring strategies will be developed over the spring and summer.

- The other MBP advisory committees (e.g., Technical Advisory Committee) also will meet over the spring and summer to detail their future roles in CCMP implementation and monitoring.

- Following approval of the CCMP, the Massachusetts Coastal Zone Management Office will continue to provide leadership to the Management Conference. MBP staff, funded by the National Estuary Program, will continue to provide guidance and technical assistance as the MBP moves into the implementation phase.

Implementation Priorities

The CCMP Action Plans reflect the overall priorities of the Management Conference. In turn, regional and community implementation of the CCMP will reflect the diverse environmental needs and priorities of the extensive Massachusetts Bays coastal area. For example, while Cape Cod communities confront groundwater pollution as a priority concern, stormwater runoff is a serious concern for Salem Sound communities. The geological, socioeconomic, and environmental diversity of the Massachusetts Bays region will be reflected in the regional and community implementation priorities and strategies developed within and by the LGCs.

Commitment to Implementation

The action recommendations in the CCMP represent five years of coordinated planning within and among the participating agencies and communities. As a result, they represent the priorities and commitments of the participants.

All four of the coastal Regional Planning Agencies have signed a resolution of support for, and commitment to, implementation of the CCMP. In December of 1995, LGC community representatives and MBP/RPA/LGC technical assistance staff began a series of ongoing meetings with the chief elected officials of the Massachusetts Bays' coastal communities. As a result of these meetings, many of the coastal communities have signed a formal resolution of support for the CCMP, which includes a voluntary commitment to implement the municipal actions appropriate to each community. In addition, each of the state and federal agencies has signed a letter committing to implement the CCMP action recommendations addressed to that agency. All of these documents are included in the full CCMP.

Taking Legislative Action

Implementation of a number of CCMP recommendations will either depend upon, or would be facilitated by, certain legislative actions at the state and local levels. Please contact the Massachusetts Bays Program office for up-to-date information regarding proposed legislation which supports CCMP implementation.

VII

Financing the CCMP

Introduction

Chapter VII of the CCMP describes the range of financing sources and mechanisms available to implement the CCMP's recommended actions. Some of the recommended actions are already underway and can be achieved with little or no additional financial resources; many others will require substantial additional funds, the source(s) of which may not be readily apparent, especially at the local level.

In this time of dwindling funds for environmental projects and increasing competition for the remaining funds, detailed and sound financial information is essential for the successful implementation of the CCMP actions. Accordingly, the MBP contracted with Northbridge Environmental Management Consultants to inventory and compile detailed information on funding sources and mechanisms. In December 1994, Northbridge produced a report entitled, *Financing the Massachusetts Bays CCMP: Federal, State, and Local Funding Sources and Mechanisms* (Financing Report, for short) with appendices and supplemental information added in early 1995. (A copy of the complete report may be obtained from your Regional Planning Office or the Massachusetts Bays Program office. Further assistance with respect to grant applications or other financial questions may be obtained from your community's representative to the MBP Local Governance Committee, or from the staff to that Committee housed at your Regional Planning Agency office).

VIII

Monitoring CCMP Implementation

Introduction

Chapter VIII of the CCMP describes an ambitious, long-term program that will be undertaken by the MBP to ensure that the CCMP recommendations are implemented and that the Program's overall goal - *the preservation and management of a healthy ecosystem of living resources, useable by the public* - is achieved.

Scientific Monitoring

Since 1990, the MBP has supported numerous scientific research and management endeavors designed to improve marine environmental quality. Research has focused on the physical processes that affect distribution and transport of constituents in the Massachusetts Bays region, the quantification of sources of contaminants such as polycyclic aromatic hydrocarbons (PAHs), and the effects of contaminants on living resources. In addition, through the Mini-Bays Program, the MBP has funded three projects to provide in-depth analysis of embayments and their watersheds, each with unique natural attributes and different management needs. Through these projects, the MBP has been able to develop priority issues on which to focus its management efforts and to develop measurable goals for the Massachusetts Bays as a whole.

The MBP Monitoring Plan is designed to measure the effectiveness of various management actions taken as part of the CCMP. Fifteen categories of activities affecting or contributing to the priority problems are listed in the CCMP. Nutrients, pathogens, toxic contaminants, and habitats have been identified as topics requiring immediate and focused attention due to their extensive occurrence in coastal Massachusetts, as well as the environmental and economic consequences of habitat degradation caused by these contaminants. Because of the need to lessen the environmental impact caused by nutrients, pathogens, and toxicants, specific measurable goals were developed for these topics and are discussed briefly in the following section. These measurable goals form the basis for one component of the monitoring plan, which is designed to measure the success of CCMP management actions. The first-tier monitoring activities associated with the measurable goals will be implemented this year. Long-term monitoring questions have been developed based on MBP-funded research projects, the Mini-Bays projects, and the need for special studies to accompany any long-term monitoring program.

In addition, a draft coastwide monitoring plan is under development by the Massachusetts Coastal Zone Management Office. An integrated approach to monitoring programs for the Commonwealth's marine waters is desired, and both the MBP's and the state's monitoring plans have been developed concurrently. However, in order to assess the success of CCMP implementation within a short time period (1-2 years) and within the available funding, the MBP's current monitoring program focuses on the Program's four measurable goals (see below). The state's monitoring plan focuses on collection of baseline data in specific embayments, long-term data collection, and ecosystem modelling. Monitoring results to date from the MBP will help formulate specific monitoring questions for the state. Data from all activities will be made available to both programs, and every effort will be made to coordinate monitoring and data collection.

The MBP marine monitoring program is also coordinated, to the extent possible, with marine and watershed monitoring efforts by other programs and agencies, including the Massachusetts Department of Environmental Protection's Office of Watershed Management (DEP/OWM), the Division of Marine Fisheries (DMF), and citizen groups.

To the extent possible, the MBP Management Conference and staff will track scientific monitoring efforts and management achievements. Based on the availability of funds, reports will be released on a regular basis. The schedule for review and reporting will be developed through the spring and summer of 1996.

Measurable Goals

The four topics for which measurable goals have been developed were chosen as issues requiring scientific and management attention throughout the Massachusetts Bays (and, in particular, through this CCMP's Action Plans). Measurable goals were developed for the four issue areas by the MBP Measurable Goals Committee, and these form the cornerstone of the Monitoring Plan. The Technical Advisory Committee (TAC) has approved the goals and refined them as necessary based on the development of the Monitoring Plan.

Nutrients

Excess nutrient inputs to coastal waters can cause water quality degradation through eutrophication, low dissolved oxygen levels, changes in community structure, and habitat loss.

Measurable Goal: Identify embayments at risk of eutrophication.

Pathogens

Improper treatment and disposal of human wastes (or other sources of pathogens) in the marine environment pose a risk to human health through contamination of shellfish beds and swimming beaches. The closure of shellfish beds due to pathogen contamination results in substantial economic loss to a number of coastal communities.

Measurable Goal: Re-open 12 shellfish beds closed due to pathogen contamination from nonpoint sources of pollution.

Toxic Contaminants

Toxic substances in coastal waters and sediments may be present at levels that cause contamination, adversely impact living resources, and further degrade the coastal environment. These effects may result in significant economic loss through a decline in harvestable fish stocks and tourism, and through the need for expensive alternatives for disposal of dredged material.

Measurable Goal: Quantify the reduction in loadings from targeted toxicant sources contributing to an identified habitat location and monitor improvement in selected biological indicators - e.g., reduce body burdens of toxic contaminants in biological resources below levels of demonstrable population effects.

Habitats

Loss of habitat such as coastal wetlands and anadromous fish runs reduces important nursery and breeding grounds for many species of marine animals, including commercial and recreational species. The loss of these resources creates economic hardship through lost revenue from decreased tourism and reduction or elimination of local fisheries businesses. In addition, loss of habitat can impair water quality and impinge upon other valued coastal amenities, such as bathing beaches and aquaculture facilities.

Measurable Goals:

- Restore 12 coastal wetland areas that have been adversely impacted due to restricted saltwater flow.
- Monitor and report the number of acres of coastal wetlands every five years to ensure no net loss of wetlands.
- Work with the Division of Marine Fisheries to provide an updated list of the locations and condition of anadromous fish runs. Based on the inventory, restore and monitor 5 anadromous fish runs.
- Define the critical habitat for 5 to 10 important species and monitor habitat conditions suitable for these selected species.

Mini-Bays Program

The Mini-Bays Program provided the opportunity to perform in-depth analysis of three embayments: Plum Island Sound, Weymouth Fore River Estuary, and Wellfleet Harbor. Each embayment project has a different focus because the locations, environmental conditions, and management challenges of each embayment are unique. Extensive baseline information is available for the Mini-Bays sites, and management activities have been implemented in the sub-watersheds, providing the opportunity to develop monitoring plans to evaluate management actions over the long-term.

Potential hypotheses for the long-term monitoring projects for the Mini-Bays Program follow:

- **Plum Island Sound:** What are the relative contributions of pathogens and nutrients from the major sources to Plum Island Sound, including the Parker River, the Ipswich River, and the Ipswich WWTP? Will the repairs to the Ipswich WWTP mitigate pathogen and nutrient flux to Plum Island Sound?

- **Weymouth Fore River:** Certain projects are being implemented in the Fore River watershed (e.g., decommissioning of the Nut Island wastewater treatment facility, the Braintree-Weymouth Interceptor project) that have environmental implications. The success of these projects will be monitored with respect to reduced loadings of toxic contaminants, nutrients, and pathogens to Fore River and Hingham Bay sediments and organisms, and for the reopening of swimming beaches and shellfish beds.

- **Wellfleet Harbor:** The Town of Wellfleet is developing a model to predict nitrogen loading to the embayment and the possible impacts of nitrogen on shellfish resources and habitats. The groundwork for this model (i.e., embayment flushing calculations, land-based and oceanic nitrogen loading estimates, and watershed build-out analysis) has been completed. However, additional field data may be needed to verify the model predictions and determine whether additional parameters should be included, such as nutrient flux from the sediments in Duck Creek. Additionally, the distribution and biomass of macroalgae in selected intertidal areas may need to be assessed and documented.

The monitoring plans for the Mini-Bays projects should be refined as the final project synthesis reports are completed this year.

Additional Monitoring

Follow-up monitoring of MBP-funded research projects can be revisited on a time-scale appropriate for a given project. For example, depending on the results of the nutrient dynamic study in the Bays (Gardner *et al.*, in progress), a small-scale sampling of selected sites may be warranted to determine changes in the ecosystem. Other projects that may require follow-up monitoring include the Merrimack River study (Menzie-Cura, 1991), nonpoint source runoff study (Menzie-Cura, 1995), and atmospheric loadings study (Golomb *et al.*, 1995). The data from these studies can be used to gauge progress toward attaining the stated measurable goals, in addition to providing a broader assessment of the status and trends of the Massachusetts Bays environment.

Special Studies

The Massachusetts Bays Program recognizes that outstanding questions remain to be answered which do not fit directly into one of the monitoring categories listed above but have relevance to the overall health and understanding of the functioning of the Bays ecosystem. As monitoring projects proceed, additional questions may arise that will need to be answered to allow proper interpretation of the collected data.

A draft of the Scientific Monitoring Plan was completed and distributed for review in June 1995, and the final draft was completed in September 1995. The complete Scientific Monitoring Plan is available through the Massachusetts Bays Program office.

Management Monitoring

In addition to "scientific" monitoring, the MBP will periodically undertake "management" monitoring to qualitatively assess the effectiveness of various implementation measures which do not lend themselves to monitoring of specific environmental indicators. The following three sections of the CCMP, for example, contain milestones, products, or other actions that are readily subject to this type of periodic, qualitative review:

What Gets Monitored?

- Chapter III, "Overview of Coastal Subregions," which includes summaries of the status of individual communities' efforts involving planning, bylaw development, and resource use and protection;

- Chapter IV, "Projects of Regional Scope and Impact," which summarizes a number of the "megaprojects" that commit state and federal agencies to certain actions in support of both the original megaproject design and the goals of the CCMP; and

- Chapter VI, "Implementing the CCMP," which establishes a framework for institutionalizing and implementing the CCMP through the Regional Planning Agencies and MBP Local Governance Committees.

Who Will Do This Monitoring, And How Will It Be Undertaken?

As previously noted, the Management Conference is the governing body for the MBP, and as such, it has overseen all aspects of the CCMP for the Massachusetts Bays. In particular, this includes establishing a network of committees who represent federal, state, and local agencies; scientists; business interests; the general public; educators; and user groups. These committees have supported development of the recommendations in the CCMP through scientific study and analysis, policy development, and education and outreach. Additional efforts will include the tracking, review, and evaluation of activities identified in the previous section.

The specific assessments to be undertaken by both the post-CCMP Management Conference, and by the MBP staff who report to the Conference, are summarized as follows:

- **Community Resource Survey:** Poll communities in the Survey to identify recently undertaken, appropriate actions which may constitute or otherwise support CCMP implementation.

- **Megaprojects:** Determine the extent to which the responsible party(ies) have implemented the recommended actions; also, assess whether the recommendations themselves continue to be appropriate.

- **Action Plans:** Interview the various parties responsible for each action to determine the status of their efforts regarding implementation; this applies to Action Plans which do not lend themselves to quantitative assessment.

- **Implementation Strategy:** Since this is the framework within which the above actions will be taken, the success of the Implementation Strategy will reflect the successful implementation of these actions.

When Will This Monitoring Be Undertaken?

As previously noted, the Management Conference, as the governing body for the MBP, will continue to exist upon completion of this CCMP and as such, will ultimately be responsible for evaluating the success of CCMP implementation. Further, with continuation of federal funding (albeit at reduced levels), and with potential funding through the Commonwealth of Massachusetts, staff support for the Management Conference will also continue. This aspect is particularly significant regarding the regional technical staff who assist the coastal communities in the MBP area, since a number of the CCMP actions identify local officials as the responsible implementing agents. These same staff also will work with state and federal agencies to facilitate additional implementation efforts.

Data Management

All MBP data sets will be made available in widely used, standard desktop formats (comma-delimited ASCII format, Excel, and Quattro Pro), and will be accompanied by digital documentation that will include a description of each data file, Quality Assurance Plan, and the Final Research Report. These data file formats can be easily incorporated into any future data bases, and the documentation will make the files discernible to future users. The data and documentation will be available for viewing and downloading via CD-ROM and/or the Internet.

MBP data include:

- MBP-funded research, demonstration projects, and Mini-Bays data sets;

- Digital files of Massachusetts Bays community map overlays; and

- New GIS data on Stellwagen Bank, Massachusetts Bays bathymetry, etc.

The MBP Data Management agenda has changed over the years from the initial vision of putting the data into a specialized, centralized structure like that of ORACLE or ODES, to an open data structure with detailed documentation and easy public access that will make the data easily available for years to come with little or no maintenance. Open formats will allow access for all potential users (e.g., Regional Planning Agencies, community officials, the MWRA, other state agencies, and private organizations), regardless of software, analytical needs, or expertise. Any future monitoring programs in Massachusetts Bays could have very specific data standards and still easily incorporate MBP data into their structure from the open formats in the MBP data base.

For more information on the MBP data sets, contact the Massachusetts Bays Program office.

Appendix A

MBP Research & Demonstration Projects

APPENDIX A
MBP RESEARCH AND DEMONSTRATION PROJECTS

Funded Research Report (1990 - 1996)

Report Title	Principal Author/Grantee	Status	Doc. Number
Sources and Loadings of Pollutants to the Massachusetts Bays (337 pp.)	Charles Menzie, Principal Investigator, Menzie-Cura & Associates	Final	MBP-91-01 October 1991
Evaluation of Elemental Tracers for Monitoring the Transport of Sewage Sludge in the Marine Environment (57 pp.)	David K. Ryan Univ. of Massachusetts/Lowell *et al.*	Final	MBP-92-02 February 1992
Physical Oceanographic Investigation of Massachusetts and Cape Cod Bays (445 pp. plus figures and appendices).	W. Rockwell Geyer Woods Hole Oceanographic Institution, *et al.*	Final	MBP-92-03 October 1992
Survival and Deposition of Fecal Bacteria in Boston Harbor Sediments (94 pp.)	Michael Shiaris Univ. of Massachusetts/Boston	Final	MBP-92-04S MBP-92-05 (Full) October 1992
The Massachusetts Bays Management System: a Valuation of Bays Resources and Uses and an Analysis of its Regulatory and Management Structure (309 pp.)	Robert Bowen Univ. of Massachusetts/Boston *et al.*	Final	MBP-93-01 June 1993
Bioavailability and Biotransformation of Hydrocarbons in Boston Harbor (68 pp.)	Anne McElroy, Principal Investigator, State University New York/Stonybrook; New York Sea Grant, *et al.*	Final	MBP-95-02 November 1994
Examining Linkages between Contaminant Inputs and their Impacts on Living Marine Resources of the Massachusetts Bays Ecosystem through Application of the Sediment Quality Triad Method (210 pp.)	Jeff Hyland Helder Costa Arthur D. Little, Inc.	Final	MBP-95-03 March 1995
Organic Loadings from the Merrimack River to Massachusetts Bay (182 pp.)	Charles Menzie, Principal Investigator, Menzie-Cura and Associates, *et al.*	Final	MBP-95-04 April 1995
Evaluation of Chemical Contaminant Effects in the Massachusetts Bays (120 pp.)	Michael Moore, Principal Investigator, Biology Dept. Woods Hole Oceanographic institution, *et al.*	Final	MBP-95-05 July 1995
Measurements and Loadings of Polycyclic Aromatic Hydrocarbons (PAH) in Stormwater, Combined Sewer Overflows, Rivers, and Publicly Owned Treatment Works (POTWs) Discharging to Massachusetts Bays (236)	Charles Menzie, Principal Investigator, Menzie-Cura & Associates, *et al.*	Final	MBP-95-06 August 1995

Report Title	Principal Author/Grantee	Status	Doc. Number
Atmospheric Deposition of Contaminants onto Massachusetts & Cape Cod Bays	Dan Golomb, Principal Investigator, Univ. of Massachusetts at Lowell, *et al.*	Draft Rec'd	In Final Review Print 3/96 (MBP-95-07)
Evaluating Costs to Communities of Management Measures to Reduce Loads to Sediments of Urban and Semi-Urban Harbors in Massachusetts Bays	Mark D. Curran Battelle Ocean Sciences Duxbury, MA 02332	Draft Rec'd	In Final Review Print 3/96
Biological and Physical Processes Controlling Nutrient Dynamics and Primary Production in Cape Cod Bay	George B. Gardner, Principal Investigator, Univ. of Massachusetts/Boston, *et al.*	In Process	Draft Due 2/96
Inventories and Concentration Profiles of Organic Contaminants in Sediment Cores from Massachusetts and Cape Cod Bays	Damian Shea, Principal Investigator, No. Carolina State University, *et al.*	In Process	Draft Due 3/96
Population Processes of Mya Arenaria from Contaminated Habitats in Massachusetts Bay	Judith E. McDowell, Woods Hole Oceanographic Institution, *et al.*	In Process	Draft Due 3/96
Geographic Analysis of Bacterial Loadings to Selected Massachusetts Bays Program Embayments	Scott Horsley, Vice President Horsley & Witten, Inc.	In Process	Draft Due 3/96
OTHER FUNDED STUDIES			
Identifying Southeast Asian Immigrant Populations at Risk from Eating Contaminated Shellfish	Jennifer Charles, Charles Consulting; Charles Menzie, Menzie-Cura & Associates	Final	MBP-95-1D May 1995
The Functions of Coastal Wetlands and the Economic Value of Coastal Wetland Restoration in Massachusetts	Dennis King, Project Manager, King & Associates	In Process	Draft Due 2/96
Impact of Contamination and Overfishing to Fisheries Resources	Robert Buchsbaum, Mass. Audubon: North Shore	In Process	Draft Due 2/96
Massachusetts Bays Monitoring Plan Components:			
An Inventory of Organic and Metal Contamination in Massachusetts Bay, Cape Cod Bay, and Boston Harbor Sediments and Assessment of Regional Sediment Quality	Jeanne Cahill and Karen Imbalzano, U. Mass./Boston	Final 1991	N/A
Identification of Embayments at Risk of Eutrophication	Charles Menzie, Menzie-Cura & Associates	In Process	Due 3/96
Assessing the Health of Mussels, mytilus edulis L., sampled during the 1995 Gulf-Watch Project.	William Robinson, U.Mass./Boston	In Process	Due 6/96

Demonstration Projects (1990 - 1996)

1991 - 1992			
North Shore			
Gloucester Dye Testing	$16,000	Expansion of an existing dye-testing project conducted by City of Gloucester Health Department. Intended result: to control direct sewage discharges from inadequate septic systems.	Walter Meyer, Health Agent City of Gloucester Health Dept. Poplar Street Gloucester, MA 01930 (508)281-9771
Boston			
Quincy Tidegate Project	$35,000	Installation of a tidegate to control tidal influx into the storm water system for the City of Quincy.	Michael C. Wheelwright Program Manager Quincy Dept. of Public Works 55 Sea Street Quincy, MA 02169-2572 (617)376-1900
South Shore			
Stormwater Drainage System Monitoring	$33,000	Maintenance, upgrade, and monitoring of stormwater drainage systems discharging into the North River in Marshfield, Norwell, Hanover, and Pembroke.	Debbie Linehan, Executive Director No. & So. Rivers Watershed Assn. P.O. Box 43 Norwell, MA 02061 (617)659-8168
Cape Cod			
Scudder Lane Stormwater Infiltration System Installation	$15,000	Installation and subsequent monitoring of a stormwater infiltration system at the parking area and boat ramp at Scudder Lane in Barnstable, and important shellfish relay area in Cape Cod Bay.	Stephen Seymour, Proj. Engineer Town of Barnstable 367 Main Street Hyannis, MA 02601 (508)790-6300
1992 - 1993			
Boston			
Winthrop Conservation Commission and Board of Selectmen	$31,000	"Lewis Lake Restoration Project": to improve water quality in a degraded coastal lake through a quantitative baseline assessment of the water quality, vegetation, and hydrology of the lake. Automate the existing manually operated tidegate, clean the area of debris, review the use of fertilizers and pesticides in the adjacent golf course, stencil storm drains which empty into the lake, and monitor recovery.	Mary Kelly, Chair Winthrop Conservation Commission Town Hall One Metcalf Square Winthrop, MA 02150 (617)846-1077

1992 - 1993 (cont'd.)			
Boston (cont'd.)			
Friends of the Boston Harbor Islands	$15,000	"Greater Boston Harbor Eelgrass Study and Island Revegetation Project" to renew and protect the native and naturalized vegetation on the harbor islands through data collection, propagation, and transplanting. Create an on-island nursery with seeds and cuttings collected from all of the islands. Create a better understanding of coastal erosion techniques through bioengineering which can be used throughout the islands and along the New England coast.	Marsha Bach Friends of the Boston Harbor Islands, Inc. P.O. Box 9025 Boston, MA 02114 (617)740-4290
Cape Cod			
Orleans / Brewster / Eastham Groundwater Protection District and Bourne Board of Health	$15,000	"De-nitrifying septic system" to perform site evaluation, and install and monitor an alternative on-site septic system: a peat system in Eastham. This system has the capacity to de-nitrify wastes. Work with DEP to get these systems approved as alternatives to the current Title V system. Conduct one educational workshop on the operation, maintenance, and regulations necessary for these systems.	Wayne McDonald District Administrator Orleans, Brewster, Eastham Groundwater Protection Dist. Overland Way - P.O. Box 2773 Orleans, MA 02653 (508)255-5744
1993 - 1994			
South Shore			
Duxbury / Kingston / Plymouth: Bluefish River Water Quality Monitoring / Habitat Restoration	$32,000	Goal of the project is improvement of near-shore water quality of Kingston-Plymouth / Duxbury embayment such that shellfish beds can be opened for commercial and recreational harvest. Cooperative working agreement among the three towns.	Joseph M. Grady, Jr. Duxbury Conservation Commission 878 Tremont Street Duxbury, MA 02332 (617)934-6586

Other 1993 Demonstration Project funding was based upon projects submitted by the five regional Local Governance Committees (LGCs). Included is a 25% non-federal match from local communities, agencies, or companies. Award: September, 1993; Completion: 1995.

North Shore LGC (8 Towns & the Bay)			
Coastal Water Quality Task Force Development	$18,090	Task forces to be established in each community in a cooperative effort to identify, monitor and mitigate non-point pollution sources. Perform shoreline surveys, conduct water quality sampling and data analysis, and enter into agreements with local sewer and water filtration labs for fecal coliform testing.	Lisa Nicol MBP Technical Assistant MVPC 160 Main Street Haverhill, MA 01830 (508)374-0519

1993 - 1994 (cont'd.)			
Salem Sound 2000 LGC			
Salem Sound Monitoring Project and Source Identification Survey	$17,000	Shoreline survey and source identification project; teams of volunteer monitors collect weekly water samples analyzed for fecal coliform bacteria. Sharing of data with appropriate municipal officials and staff. Program.	Nancy Goodman MBP Technical Assistant MAPC 60 Temple Place Boston, MA 02111 (617)451-2770
Metro Boston LGC			
Pilayella littoralis Research	$6,000	Funding to Northeastern University's Marine Science Lab in Nahant for study of the biology of *Pilayella littoralis*. Results to provide information for the successful timing and location of harvesting efforts.	Dr. Don Cheney Northeastern University East Point Marine Science Lab. Nahant, MA 01908 (617)581-7370
South Shore LGC			
Water Quality Monitoring Project	$17,000	Monitoring to occur in the communities of Weymouth, Cohasset, Scituate, and Marshfield.	Bill Clark, MBP Tech. Asst. MAPC 60 Temple Place Boston, MA 02111 (617)451-2770
Cape Cod LGC			
Alternative On-Site Waste Technologies Development	$17,400	Hiring of part-time technical assistant to work with Cape Cod communities in the development of alternative septic technologies.	Patricia Hughes, MBP Tech. Asst. Cape Cod Commission 3225 Main Street Barnstable, MA 02630 (508)362-3828
1994 - 1995			
North Shore (8 Towns & the Bay)			
Town of Essex Septic System Evaluation	$19,000	Town-wide door-to-door survey of existing septic systems, examination of Board of Health records, and compilation of data resulting in remediation recommendations.	Lisa Nicol, MBP Tech. Asst. MVPC 160 Main Street Haverhill, MA 01830 (508)374-0519
Salem Sound 2000			
Water Quality Monitoring	$19,000	Ongoing water quality monitoring program and establishment of coastal water quality task forces in each community to work on specific projects (continuation funding).	Nancy Goodman, MBP Tech. Asst. MAPC 60 Temple Place Boston, MA 02111 (617)451-2770
Metro Boston LGC			
Waste Oil Collection Center	$4,400	Establishment of waste oil collection center in Revere to reduce pollutants entering municipal storm water systems. A tank will be purchased, installed and operated for several years. It will be the city's responsibility for additional construction costs, operation, promotion, and disposal.	Bill Clark MBP Technical Assistant MAPC 60 Temple Place Boston, MA 02111 (617)451-2770

1994 - 1995 (cont'd.)			
Metro Boston LGC (cont'd.)			
Metro Boston Area Contaminated Shellfish Harvesting Study	$5,000	Phase I of project to identify geographic areas and ethnic populations that are at risk from eating contaminated shellfish.	Nancy Goodman MAPC 60 Temple Place Boston, MA 02111 (617)451-2770
Neponset River Watershed Bylaw Development	$8,000	Development of a stormwater bylaw, based on stormwater modeling, for communities in the Neponset River basin. Developed by MAPC in partnership with MA Coastal Zone Management, US Natural Resources Conservation Service, Boston Water & Sewer Dept., and Neponset River Watershed Association.	Martin Pillsbury MAPC 60 Temple Place Boston, MA 02111 (617)451-2770
South Shore			
Water Quality Monitoring	$2,000	To identify pollution sources in the Herring River in Scituate.	Debbie Linehan No. & So. Rivers Watershed Assn. P.O. Box 43 Norwell, Ma 02061 (617)659-8168
Cape Cod			
Alternative On-Site Waste Technologies Development	$20,000	Continuation of part-time technical assistant to work with Cape Cod communities in the development of alternative septic technologies.	Patricia Hughes MBP Technical Assistant Cape Cod Commission 3225 Main Street Barnstable, MA 02630 (508)362-3828
1995 - 1996			
North Shore (8 Towns & the Bay)			
Four Community Projects (in the planning stages)	$15,000		Lisa Nicol M.V.P.C. 160 Main Street Haverhill, MA 01830 (508)374-0519
Salem Sound 2000			
Water Quality Monitoring	$15,500	Ongoing water quality monitoring program and establishment of coastal water quality task forces in each community to work on specific projects they develop (continuation funding).	Nancy Goodman MBP Technical Assistant M.A.P.C. 60 Temple Place Boston, MA 02111 (617)451-2770
Metro Boston Area			
Youth Environmental Action Summer Program	$5,000	Funding of 10-week "Harbor Vision Crew '95" peer education and service program for schools in the cities of Cambridge, Chelsea, Somerville, and Boston.	Jodi Sugerman Save the Harbor/Save the Bay 25 West Street Boston, MA 02111 (617)451-2860

1995 - 1996 (cont'd.)			
Metro Boston Area (cont'd.)			
Neponset River Water Quality Monitoring	$2,500	Citizen monitoring program to identify potential pollution sources in the Neponset River between Mother Brook section and the Lower Mills Falls.	Ian Cook Neponset River Watershed Assn. 2438 Washington Street Canton, MA 02021 (617) 575-0354
Storm Drain Stenciling	$4,000	Stenciling of storm drains throughout the metropolitan Boston area, indicating that the storm drains dump directly into Boston Harbor.	Nancy Goodman MAPC 60 Temple Place Boston, MA 02111 (617)451-2770
South Shore			
Water Quality Monitoring	$2,000	To identify pollution sources in the Herring River in Scituate. North and South Rivers Watershed Assn.	Debbie Linehan P.O. Box 43 Norwell, Ma 02061 (617)659-8168
Water Quality Monitoring	$2,055	To determine nitrogen levels and fecal coliform bacteria counts in the Billington Sea, Plymouth, in conjunction with Old Colony Planning Council, Natural Resources Conservation Service, and Massachusetts Department of Environmental Protection.	Mike Conrad Director of Water Monitoring Billington Sea Association 33 Hopkins Road Plymouth, MA 02360 (508)747-5510
Title 5 Septic System Municipal Data Base	$11,400	Purchase of FoxPro software, one copy for each South Shore Local Governance Committee municipal Board of Health, to compile DEP-required information on each septic system in a municipality. Contract to develop database and translate municipal assessor data to the system. Input data to municipal computers.	Bill Clark MAPC 60 Temple Place Boston, MA 02111 (617)451-2770
Pollution Source Identification	$1,600	Purchase of smoke testing equipment for use by all South Shore communities (via DPW /Board of Health) in conjunction with the Massachusetts Division of Marine Fisheries.	Bill Clark MAPC. 60 Temple Place Boston, MA 02111 (617)451-2770
ACEC Management Plan	$2,500	Work with the Back River Committee in Weymouth and Hingham to develop a resource management plan for their ACEC.	Tom Burbank 17 Andrews Isle/P.O. Box 185 Hingham, MA 02043 (617)749-9473

Appendix B

MBP Committees and Staff

POLICY COMMITTEE

Trudy Coxe, Secretary, Commonwealth of Massachusetts Executive Office of Environmental Affairs, Co-Chair

John DeVillars, Regional Administrator, US Environmental Protection Agency - New England, Co-Chair

MANAGEMENT COMMITTEE

Diane Gould, Massachusetts Bays Program, Chair

Peg Brady, Massachusetts Coastal Zone Management Office
Leigh Bridges, Massachusetts Division of Marine Fisheries
Faith Burbank, Education Alliance Steering Committee
Gaylord Burke, Merrimack Valley Planning Commission
Michael Connor, Massachusetts Water Resources Authority
Ralph Cox, Massachusetts Port Authority
Richard Delaney, Urban Harbors Institute
Cathy Demos, US Army Corps of Engineers - New England Division
Jane Downing, US Environmental Protection Agency - New England
*Stewart Fefer, US Fish and Wildlife Service/Gulf of Maine Project
Pat Eldridge, c/o Senator Henri Rauschenbach/Coastal Caucus
Joan Foster, South Shore Local Governance Committee (LGC)
*Peter Gagnon, Massachusetts Department of Public Health
Stephen Greene, Business and Resource Users Group
*Janeen Hansen, Massachusetts Port Authority
*Carol Hanson, US Natural Resources Conservation Service
Pat Hughes, Cape Cod Commission
Russell Isaac, Massachusetts Department of Environmental Protection
Elaine Krueger, Massachusetts Department of Public Health
Peter LaPolla, Metro Boston LGC
*Wendy Leo, Massachusetts Water Resources Authority
Leslie Luchonok, Massachusetts Department of Environmental Management
Marc MacQueen, US Natural Resources Conservation Service
Sharon McGregor, Massachusetts Executive Office of Environmental Affairs
Judy Pederson, Technical Advisory Committee
Martin Pillsbury, Metropolitan Area Planning Council
James Povey, Salem Sound 2000 LGC
Henri Rauschenbach, Massachusetts Senate
William Robinson, University of Massachusetts-Boston
Jodi Sugerman, Coastal Advocacy Network (CAN) Co-Chair
Frederick (Ted) Tarr, 8 Towns and the Bay LGC
Patricia Trombly, Massachusetts Highway Department
Maria Van Dusen, Massachusetts Division of Fisheries, Wildlife and Environmental Law Enforcement
James Watson, Old Colony Planning Council
Mason Weinrich, CAN Co-Chair
Mark Zivan, Cape Cod Coastal Resources Committee LGC

TECHNICAL ADVISORY COMMITTEE

Judy Pederson, MIT Sea Grant Program, Co-Chair
Bill Robinson, University of Massachusetts-Boston, Co-Chair

Eric Adams, MIT-Civil Engineering Department
Andrea Arenovski, Marine Studies Consortium
Arnold Banner, US Fish and Wildlife Service, Gulf of Maine Project
Leigh Bridges, Massachusetts Division of Marine Fisheries
Robert Buchsbaum, Massachusetts Audubon Society: North Shore
Brad Butman, US Geological Survey-Woods Hole
Mark Chandler, New England Aquarium
Michael Connor, Massachusetts Water Resources Authority
Martin Dowgert, US Food and Drug Administration
Kenneth Finkelstein, National Oceanic and Atmospheric Administration/US Environmental Protection Agency - New England
Mike Gildesgame, Massachusetts Department of Environmental Management
*Debbie Graham, Massachusetts Department of Environmental Management
Paula Kullberg, US Army Corps Engineers
Robert Lent, US Geological Survey
*Wendy Leo, Massachusetts Water Resources Authority
Matt Liebman, US Environmental Protection Agency - New England
*Mike Mikelson, Massachusetts Water Resources Authority
Julianne Nassif, Massachusetts Department of Public Health
Jerry Pesch, US Environmental Protection Agency/Environmental Research Lab
Dave Ryan, University of Massachusetts-Lowell
Dale Saad, Barnstable Health Department
Mike Shiaris, University of Massachusetts-Boston
David Terkla, University of Massachusetts-Boston
Tracy Villareal, University of Massachusetts-Boston

BUSINESS AND RESOURCE USERS GROUP

Business Participants

Stephen Greene, Polaroid Corporation, Chair

Scott Cassel, Massachusetts Executive Office of Environmental Affairs
Joy Conway, Greater Boston Real Estate Board
Roy Crystal, Goldman Environmental
Diane Davis, Schneider and Associates
Betty Diener, Environmental Business Council of New England
Peggy Fantozzi, R.H. Cole Associates
Larry Goldman, Goldman Environmental/Small Business Association of New England
Bob Ingram, Daylor Consulting Group
Vivien Li, The Boston Harbor Association
Renato Miele, Environmental Business Council/University of Massachusetts
Dan Moon, Longwood Environmental Management
Joseph Newman, Greater Boston Chamber of Commerce
Bob Ruddock, Associated Industries of Massachusetts
Claudia Smith-Reid, Massachusetts Water Resources Authority

BUSINESS AND RESOURCE USERS GROUP Continued

Resource Users Participants

Bill Adler, Massachusetts Lobstermen's Association
Andy Ayer, Quincy Shellfish Department/Massachusetts Shellfish Officer's Association
Al Frizelle, Boston Shipping Association/Charlestown Navy Yard
Tom Gloria, New England Aquarium Divers Club
John Grabski, Massachusetts Bay Yacht Club Association
John Hicks-Courant, Divers' Environmental Survey
John Sheehy, Massachusetts Harbormasters Association

COASTAL ADVOCACY NETWORK

Jodi Sugerman, Save the Harbor/Save the Bay, Co-Chair
Mason Weinrich, Cetacean Research Unit, Co-Chair

Steve Aubrey, Association for the Preservation of Cape Cod
Gaye and Tom Berube, Massachusetts Sportsmen's Council
Polly Bradley, S.W.I.M. (Safer Waters in Massachusetts)
Robert Buchsbaum, Massachusetts Audubon: North Shore
Paul Burns, MassPIRG (Public Interest Research Group)
Priscilla Chapman, Fall River Conservation Commission
Russell DeConti, Center for Coastal Studies
Richard Delaney, Urban Harbors Institute
Gay Gillespie, Westport River Watershed Association
Tom Gloria, New England Aquarium Divers Club
Eileen Gunn, Coalition for Buzzards Bay
Nancy Ho, Association for the Preservation of Cape Cod
Joan LeBlanc, The Boston Harbor Association
Vivien Li, The Boston Harbor Association
Mary Loebig, S.T.O.P (Stop the Outfall Pipe)
Bob Loring, Clean Water Action
Jay McCaffrey, New England Sierra Club
Valerie Nelson, Coalition for Alternative Wastewater Treatment
Susan Nickerson, Association for the Preservation of Cape Cod
Stephan Nofield, Bays Legal Fund
Susan Redlich, Massachusetts Water Resources Authority/Wastewater Advisory Committee
Peter Shelley, Conservation Law Foundation
Caroline Simmons, New England Environmental Network
Roger Stern, Marine Studies Consortium
Alison Walsh, Save the Bay
Metti Whipple, Plymouth First
Jack Wiggin, Coastal Resources Advisory Board/Urban Harbors Institute
John Williams, Massachusetts Toxics Campaign
Paul Wingle, Environmental League of Massachusetts
Julie Wormser, New England Environmental Network

EDUCATION ALLIANCE STEERING COMMITTEE

Reed Stewart, Bridgewater State College, Chair
Faith Burbank, University of Massachusetts Cooperative Extension Service, Facilitator
Janis Burton, Manomet Bird Observatory
Ellie Calhoun, New England Aquarium
Susan Carver
Jack Crowley, Hingham High School
Cindy Delpapa, Saugus River Watershed Council
Barbara Egon, Massachusetts Audubon Society/Ipswich River Wildlife Sanctuary
Laura Kursman, Massachusetts Department of Environmental Protection
Stafford Madison, US Environmental Protection Agency - New England
Jay Moore, Salem State College (retired)
Alan Morich, Cape Cod Museum of Natural History
Rhoda Peck, University of Massachusetts Cooperative Extension Service
Jean Pena, Marine Education Center of Cape Ann
Bobbie Robinson, Commonwealth Museum
Ann Rodney, US Environmental Protection Agency - New England
Agnes Smith, University of Massachusetts Cooperative Extension Service
Anne Smrcina, Stellwagen Bank National Marine Sanctuary
Maria Van Dusen, Massachusetts Riverways Program
Barbara Waters, University of Massachusetts Cooperative Extension Service
Janey Winchell, Peabody-Essex Museum
David Woolley, Cetacean Research Unit

LOCAL GOVERNANCE COMMITTEES

Eight Towns and The Bay (Upper North Shore LGC)

Steve Barrett, Massachusetts Coastal Zone Management
Derek Brown, Town of Essex
Curtis Bryant, Town of Rowley
Gaylord Burke, Merrimack Valley Planning Commission
Wayne Castonguay, Town of Ipswich
Robert Cram, Town of Ipswich
Wayne David, Town of Salisbury
Stephan Gersh, Town of Essex
Jill Haley-Murphy, City of Newburyport
Alan Macintosh, Merrimack Valley Planning Commission
Ruth Perrault, Town of Rockport
Dave Sargent, City of Gloucester
Frederick (Ted) Tarr, Town of Rockport

Salem Sound 2000 LGC

Russell Vickers, Hawthorne Cove Marina, Chair

Curt Bellavance, City of Peabody
Helen Bethell, Town of Manchester
Joan Cannon, New England Power Company
Brad Chase, Massachusetts Division of Marine Fisheries - Cat Cove Marine Laboratory

LOCAL GOVERNANCE COMMITTEES Continued

Salem Sound 2000 LGC Continued

Sam Cleaves, Salem Sound 2000 Program Coordinator
Fara Courtney, The Industrial Services Program
Rebecca Curran, Town of Marblehead
Steve De Crosta, Town of Danvers
Steve Dibble, City of Salem
Lisa Evans, Town of Marblehead
Peter Gilmore, City of Beverly
Debra Hurlburt, City of Beverly
Christy Jones, Peabody-Essex Museum
Martine Kellett, New England Biolabs Foundation
Joan LeBlanc, City of Salem
John Marino, City of Peabody
Jay Moore, Town of Marblehead
Peter Ness, Stahl, USA
Faith Ortins, Northeast Scuba
James Povey, City of Beverly
Juli Riemenschneider, City of Salem
David Rimmer, The Trustees of Reservations
Tracey Roberts, Town of Danvers
David Roy, Eastman Gelatine Corporation
Thomas Schley, Salem Maritime National Historic Site
Ruth Taylor, South Essex Sewerage District
Janey Winchell, Peabody-Essex Museum
Dr. Alan Young, Salem State College

Metro Boston LGC

Peter LaPolla, Town of Braintree, Co-Chair
Mark Reich, Esq., City of Everett, Co-Chair

David Colton, City of Quincy
Mary Corcoran, Town of Winthrop
John DePriest, City of Chelsea
Lorraine Downey, City of Boston
Geralyn Falco, Town of Swampscott
Jean Fasano, Town of Saugus
Ken Fields, City of Boston
Jim Greene, Town of Milton
Betsy Russell Hickey, Town of Nahant
Amy Keith, Boston Water and Sewer Commission
Richard Mertens, Boston Redevelopment Authority
Martin Pillsbury, Metropolitan Area Planning Council
Steven Smith, City of Lynn
Frank Stringi, City of Revere
*Mike Wheelwright, City of Quincy
Jack Wiggin, Urban Harbors Institute

LOCAL GOVERNANCE COMMITTEES Continued

South Shore LGC

Joan Foster, Town of Scituate, Chair

Sara Altherr, Jones River Watershed Association/Town of Kingston
Linda Beres, Town of Hull
Faith Burbank, University of Massachusetts Cooperative Extension Service/Education Alliance Steering Committee
*Jean Christensen, Metropolitan Area Planning Council
*Clifford DeBaun, Town of Plymouth
Peter Dillon, Town of Norwell
Joe Grady, Town of Duxbury
John Hartshorne, Gulf Association
Bruce Hughes, Old Colony Planning Council
Bill Johnson, Back River Committee/Town of Weymouth
Jack Lennox, Town of Plymouth
Marc MacQueen, US Natural Resources Conservation Service
Deborah McKie, Jones River Watershed Association/Town of Hanover
*Brian Murphy, Town of Cohasset
Joanne Owen, Town of Pembroke
Peter Rosen, Town of Hingham
Jim Watson, Old Colony Planning Council

Cape Cod Coastal Resources Committee LGC

*Mark Zivan, Town of Orleans, Chair

*Neil Allen, Town of Eastham
*Robert Bainton, Town of Yarmouth
Brenda Boleyn, Town of Truro
Thomas Broidrick, Town of Yarmouth
*David Carlson, Town of Brewster
Bill Burt, University of Massachusetts Cooperative Extension Service
Russell Cookingham, Town of Bourne
*Tanya Dagneault, Town of Dennis
David DeConto, Town of Sandwich
David Ditacchio, Town of Provincetown
Bob Duncanson, Town of Chatham
Alice Fischer, Cape Cod Sierra Club
George Hampson, Town of Falmouth
James Hanks, Town of Mashpee
George Heufelder, Barnstable County Health and Environment Department
*Thomas Leach, Town of Harwich
Muriel Lightfoot, Town of Eastham
Donald Liptack, US Natural Resources Conservation Service
Bob Mant, Town of Brewster
Alan Marcy, Town of Dennis
*Richard Prince, Town of Bourne
Roger Putnam, Town of Wellfleet
Michael Reynolds, Cape Cod National Seashore
Jack Rosenquest, Town of Orleans

LOCAL GOVERNANCE COMMITTEES Continued

Cape Cod Coastal Resources Committee LGC Continued

Dale Saad, Town of Barnstable
*Margaret Swanson, Town of Chatham
R. Gregory Taylor, Assembly of Delegates
*Bruce Tripp, Woods Hole Oceanographic Institute
*Steven Tucker, Town of Sandwich
*Mardee Verdina, Town of Truro

* Alternate Member

MASSACHUSETTS BAYS PROGRAM STAFF

Diane Gould, Ph.D, Executive Director

Bill Clark, Technical Assistant, Metro Boston and South Shore LGCs, Metropolitan Area Planning Council
Nancy Goodman, Technical Assistant, Metro Boston and Salem Sound 2000 LGCs, Metropolitan Area Planning Council
Pat Hughes, Technical Assistant, Cape Cod Coastal Resources Committee LGC, Cape Cod Commission
Deirdre Kimball, Manager, Interagency Shellfish Bed Restoration Program
Ruth Kuykendall, Assistant to the Executive Director
Alan Macintosh, Environmental Program Manager, Merrimack Valley Planning Commission
Betsy McEvoy, Director of Public Policy and Outreach
Lisa Nicol, Technical Assistant, 8 Towns and the Bay LGC, Merrimack Valley Planning Commission
Ann Riley, Grants Administrator, Urban Harbors Institute
Susan Schneider, Public Information Specialist
Dillon Scott, Data Manager
Marie Studer, Ph.D., Staff Scientist
Tara Tracy, Program Manager, US Environmental Protection Agency -New England

Note: All committee members and staff are current as of March, 1996.

Appendix C

Bibliography

Alber, M., and A.B. Chan. 1994. Sources of contaminants to Boston Harbor: revised loadings estimates. MWRA Environmental Quality Department Technical Report No. 94-1. Massachusetts Water Resources Authority, Boston, MA. 93 pp.

Battelle Ocean Sciences. In progress. Evaluating costs to communities of management measures to reduce loads to sediments of urban and semi-urban harbors in Massachusetts Bay. Massachusetts Bays Program, Boston, MA.

Bowen, R., J. Archer, D. Terkla, and J. Myers. 1992. The Massachusetts Bays management system: A valuation of Bays resources and uses and an analysis of its regulatory and management structure. MBP-90-01. Massachusetts Bays Program, Boston, MA.

Buchsbaum, R., J. Pederson and W. Robinson (Eds). In progress. The role of overfishing, pollution, and habitat degradation on marine fish and shellfish populations of New England. Massachusetts Bays Program, Boston, MA.

Buchsbaum, R. 1992. Turning the tide: toward a livable coast in Massachusetts. Massachusetts Audubon Society, Lincoln, MA.

Cahill, J. and K. Imbalzano. 1991. An inventory of organic and metal contamination in Massachusetts Bay, Cape Cod Bay, and Boston Harbor sediments and assessment of regional sediment quality. Massachusetts Bays Program, Boston, MA.

Cavanaugh, E.F., and L.R. Lewis. 1990. The state of our harbors: an examination of Massachusetts Harbor conditions and related economic parameters. Rivers and Harbors Program Report. Division of Waterways, Massachusetts Department of Environmental Management, Hingham, MA.

Chase, B. 1994. Massachusetts Bay smelt spawning habitat monitoring program. New England Estuarine Research Society meeting, June 2-4, Salem State College, MA.

Cooper A., and R. Buchsbaum. 1994. Plum Island Sound/Rivers system final action plan. Massachusetts Audubon: North Shore, Massachusetts Bays Program Mini-Bay Project. 23 pp., plus appendices.

Correia, S.J. 1992. Flounder population declines: overfishing or pollution? DMF News. MA DMF Publication #17020-12-7000-7/92. pp. 2-5. Massachusetts Division of Marine Fisheries, Boston, MA.

Costa, J.E. 1988a. Distribution, production, and historical changes in abundance of eelgrass (Zostera marina L.) in southeastern Massachusetts. Ph.D. Dissertation, Boston University, Boston, MA.

Costa, J.E. 1988b. Eelgrass in Buzzards Bay: distribution, production and historical changes in abundance. U.S. EPA 503/4-88-002 and BBP-88-05. U.S. Environmental Protection Agency Office of Water and Region 1, and Buzzards Bays Program, Boston, MA.

Cura, J.J. 1991. Review of phytoplankton data: Massachusetts Bay. MWRA Technical Report No. 91-1. Massachusetts Water Resources Authority, Boston, MA.

Cura, J.J., and J. Freshman. 1992. Nitrogen loading to Massachusetts Bay. New England Estuarine Research Society meeting, November 5-7, Wells, ME.

Executive Office of Environmental Affairs. 1990. An environment at risk: the first annual report on the state of the Massachusetts environment. Commonwealth of Massachusetts. 129 pp.

Gardner, G.R. and R.J. Pruell and L.C. Folmar. 1989. A comparison of both neoplastic and non-neoplastic disorders in winter flounder (Pseudopleuronectes americanus) from eight areas in New England. Marine Environmental Research. 28: 393-397.

Gardner, G.B., T.A. Villareal, and T. Loder. In progress. Biological and physical processes controlling nutrient dynamics and primary production in Cape Cod Bay. Massachusetts Bays Program. Massachusetts Bays Program, Boston, MA.

Geyer, W.R., G.B. Gardner, W.S. Brown, J. Irish, B. Butman, T. Loder, and R. Signell. 1992. Physical oceanographic investigation of Massachusetts and Cape Cod Bays. MBP-92-03. Massachusetts Bays Program, Boston, MA.

Golomb, D., D. Ryan, N. Eby, J. Underhill, T. Wade, and S. Zemba. 1996. Atmospheric deposition of trace metals and polycyclic aromatic hydrocarbons onto Massachusetts Bays. Massachusetts Bays Program, Boston, MA.

Hankin, A.L., L. Constantine, and S. Bliven. 1985. Barrier beaches, salt marshes, and tidal flats. An inventory of the coastal resources of the Commonwealth of Massachusetts. Lloyd Center for Environmental Studies and MCZM Program Publication 13899-27-600-1-85 C.R.

Heufelder, G. 1988. Bacterial monitoring in Buttermilk Bay. EPA 503/4-88-001. U.S. EPA Region 1, Boston, MA.

Horsley and Witten, Inc. In progress. Geographic analysis of bacterial contamination: Ipswich, Beverly and Provincetown watershed studies. Massachusetts Bays Program, Boston, MA.

Hyland, J.L., and H. Costa. 1995. Examining linkages between contaminant inputs and their impacts on living marine resources of the Massachusetts Bay ecosystem through application of the sediment quality triad method. MBP-95-03. Massachusetts Bays Program, Boston, MA.

Ipswich Shellfish Advisory Board. 1991. Shellfishing in Ipswish, 1991: Pollution and its effect on shellfishing. Ipswich, MA. 28 pp.

Johnson, L.L., C.M. Stehr, O.P. Olson, M.S. Myers, S.M. Pierce, C.A. Wigern, B.B. McCain and U. Varanasi. 1993. Chemical contaminants and hepatic lesions in winter flounder (Pleuronectes americanus) from the northeast coast of the United States. Environmental Science and Technology, 27:2759-2771.

Kelly, J.R. 1991. Nutrients and Massachusetts Bay: A synthesis of eutrophication issues. MWRA Technical Report No. 91-10. Massachusetts Water Resources Authority, Boston, MA. 66 pp.

Kelly, J.R. 1993. Nutrients and Massachusetts Bay: An update of eutrophication issues. MWRA Environmental Quality Department Technical Report No. 93-17. Massachusetts Water Resources Authority, Boston, MA. 119 pp.

King, Dennis. In progress. The functions of coastal wetlands and the economic value of coastal wetland restoration in Massachusetts. Massachusetts Bays Program, Boston, MA.

Knebel, H.J, R. Rendigs and M. Bothner. 1991. Modern sedimentary environments in Boston Harbor, Massachusetts. Journalof Sedimentary Petrology 61(5):791-804.

Leonard, D.L., M.A. Broutman and K.E. Harkness. 1989. The quality of shellfish growing waters on the east coast of the United States. U.S. Department of Commerce, NOAA Strategic Assessment Branch, Rockville, MD.

MacDonald, D.A. 1991. Status and trends in concentrations of selected contaminants in Boston Harbor sediments and biota. NOAA Technical Memorandum NOS OMA 56, National Oceanic and Atmospheric Administration, Seattle, WA.

Massport. 1995. Port of Boston economic development plan. Massport Authority, Boston, MA.

McDowell, J., D.F. Leavitt, and D. Shea. In progress. Population processes of Mya Arenaria from contaminated habitats in Massachusetts Bay. Massachusetts Bays Program, Boston, MA.

McElroy, A., M. Shiaris and J. McDowell. 1994. Bioavailability and biotransformation of polycyclic aromatic hydrocarbons in benthic environments of coastal Massachusetts. Massachusetts Bays Program, Boston, MA.

Menzie-Cura & Associates. 1991. Sources and loadings of pollutants to the Massachusetts Bays. MBP-91-01. MassachusettsBays Program, Boston, MA.

Menzie-Cura & Associates. 1995a. Organic loadings from the Merrimack River to Massachusetts Bay. MBP-95-04. Massachusetts Bays Program, Boston, MA.

Menzie-Cura & Associates. 1995b. Measurements and loadings of polycyclic aromatic hydrocarbons (PAHs) in stormwater, combined sewer overflows, rivers, and publicly owned treatment works (POTWs) discharging to Massachusetts Bays. MBP-95-06. Massachusetts Bays Program, Boston, MA.

Moore, M. J., B.R. Woodin, and J.R. Stegeman. 1992. Liver pathology of winter flounder: Boston Harbor, Massachusetts Bay, and Cape Cod Bay — 1991. MWRA Environmental Quality Department Technical Report No. 92-5. Massachusetts Water Resources Authority, Boston, MA.

Moore, M. J. and J.R. Stegeman. 1993. Liver pathology of winter flounder: Boston Harbor, Massachusetts Bay, and Cape Cod Bay — 1992. MWRA Environmental Quality Department Technical Report No. 93-7. Massachusetts Water Resources Authority, Boston, MA.

Moore, M.J., R.M. Smolowitz, D.F. Leavitt, and J.J. Stegeman. 1995. Evaluation of chemical contaminant effects in the Massachusetts Bays. MBP-95-05. Massachusetts Bays Program, Boston, MA.

National Oceanic and Atmospheric Administration. 1990. Estuaries of the United States: Vital statistics of a national resource base. U.S. Dept. of Commerce, NOAA Strategic Assessment Branch, Rockville, MD.

National Oceanic and Atmospheric Administration. 1993. Stellwagen Bank National Marine Sanctuary: Final environmental impact statement/management plan. NOAA Sanctuaries and Reserves Division, U.S. Department of Commerce, Washington, DC.

Orth, R.J., and K.A. Moore. 1983. Chesapeake Bay: An unprecedented decline in submerged aquatic vegetation. Science 222:51-53.

Reback, K.E., and J.S. DiCarlo. 1972. Final completion report. Anadromous fish project. MA DMF Publication #6496 (115-50-12-72-CR). Massachusetts Division of Marine Fisheries, Boston, MA.

Rex, A.C., K.E. Keay, W.M. Smith, J.J. Cura, C.A. Menzie, M.S. Steinhauer, and M.S. Connor. 1992. The state of Boston Harbor: 1991. MWRA Technical Report No. 92-3. Massachusetts Water Resources Authority, Boston, MA.

Roach, D.A. 1992. A sanitary survey of Essex Bay in Essex, Gloucester, and Ipswich, Massachusetts, Area N7. MassachusettsDivision of Marine Fisheries Shellfish Sanitation and Management Program. 36 pp. plus appendices.

Schwartz, J., N. Duston, and C. Batdorf. 1991. PCBs in winter flounder, American lobster, and bivalve molluscs from BostonHarbor, Salem Harbor and coastal Massachusetts: 1984-1989. MA DMF Publication #16,966-63-250-10-91-C.R. Massachusetts Division of Marine Fisheries, Boston, MA.

Shea, D. In progress. Accumulation, inventory and budget of polycyclic aromatic hydrocarbons in Massachusetts Bays sediments. Massachusetts Bays Program, Boston, MA.

Sullivan, P.A., and W.E. Robinson. 1990. The health of winter flounder from Boston Harbor. A summary of results from FishDay, May 13, 1989. Edgerton Research Laboratory, New England Aquarium, Boston, MA.

Townsend, D., L.M. Cammen, J.P. Christensen, S.G. Ackelson, M.D. Keller, E.M. Haugen, S. Corwin, W.J. Bellows, and J.F.Brown. 1990. Seasonality of oceanographic conditions in Massachusetts Bay. Bigelow Laboratory for Ocean Sciences Final Report to the Massachusetts Water Resources Authority, Boston, MA.

Uhler, A.D., D.E. West, and C.D. Hunt. 1994. Deer Island effluent characterization June - November, 1993. MWRA Environmental Quality Department Technical Report No. 94-4. Massachusetts Water Resources Authority, Boston, MA.

U.S. EPA Region 1. 1988a. Analysis of risks from consumption of Quincy Bay fish and shellfish. U.S. EPA Region 1, Boston, MA.

U.S. EPA Region 1. 1988b. Assessment of Quincy Bay contamination: summary report. U.S. EPA Region 1, Boston, MA.

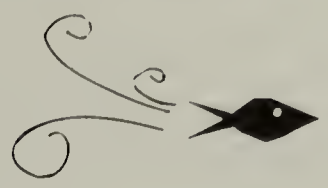
U.S. EPA Region 1. 1993. Assessment of potential impact of the MWRA outfall on endangered species. U.S. EPA Region 1. Boston, MA.

Williams, F.P., and G.S Fout. 1992. Contamination of shellfish by stool-shed viruses: methods of detection. Environmental Science and Technology 26(4):689-696.

Witman, J.D. 1994. Rocky subtidal communities in Massachusetts: Lovell Island to Nahant Transect. A final report on the 1992-1993 sampling period. Massachusetts Water Resources Authority Report #94-16. 83 pp.

Zemba, S. G. 1996. Atmospheric deposition of nitrogen compounds to Massachusetts Bays. Massachusetts Bays Program, Boston, MA.

Acknowledgements

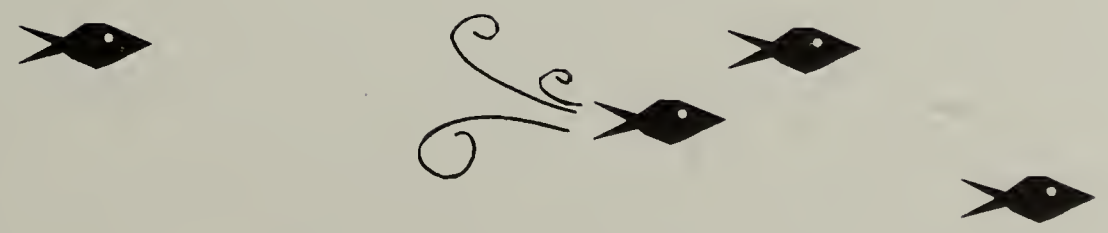


The Massachusetts Bays Program Comprehensive Conservation and Management Plan (CCMP) is the work of many dedicated people. Many thanks to Secretary Trudy Coxe, Massachusetts Executive Office of Environmental Affairs (EOEA), and Regional Administrator John DeVillars, United States Environmental Protection Agency (EPA), for their ongoing involvement and support. The preparation of the CCMP was the result of an innovative contractual agreement with the Merrimack Valley Planning Commission (MVPC) and we would especially like to acknowledge Alan Macintosh, Environmental Program Manager for MVPC, who served with unflagging commitment and enthusiasm as CCMP planner and principal author, and Celine Bernier (MVPC), whose typing and formatting skills contributed to the preparation of this document. State staff from the Massachusetts Bays Program (MBP) who participated in the development of the document include Diane Gould, Betsy McEvoy, Dillon Scott, Marie Studer, Ruth Kuykendall, and Susan Schneider. Regional Planning Agency MBP staff participants included Lisa Nicol, MVPC; Nancy Goodman and Bill Clark, Metropolitan Area Planning Council (MAPC); and Patricia Hughes, Cape Cod Commission (CCC). Faith Burbank, U. Mass Extension, also assisted. The Environmental Protection Agency contributors included Tara Tracy, Matthew Liebman, and Carol Kilbride. Members of the Massachusetts Bays Program Steering Committee, including Peg Brady, Director, Massachusetts Coastal Zone Management (MCZM); Jane Downing, EPA; Russ Isaac and Larry Gil, DEP; Gaylord Burke, MVPC; Armando Carbonell, CCC; Martin Pillsbury, MAPC; Joan Foster, South Shore Local Governance Committee (LGC); Peter LaPolla, Metro Boston LGC; Ted Tarr, 8 Towns and the Bay; Jim Povey, Salem Sound 2000; Jim Watson, Old Colony Planning Council; Judy Pederson, MIT Sea Grant; and William Robinson, U. Mass/Boston, helped to guide the development of the CCMP.

Many others made invaluable contributions throughout the five years of planning that led to this document. A list of Massachusetts Bays Program Committee members and staff is found in Appendix B. We would like to thank each of these individuals for their assistance and ongoing commitment. We would especially like to thank our tireless committee chairs for their dedication. In addition to those names noted in the list, we would like to thank old friends who served in the past as chairs of Massachusetts Bays Program committees, including Alan Hankin, Gwen Ruta, Jack Pitman, Mark Norton, John Farrington, Gordon Wallace, Jay Kaufman, Dan Curll, Jack Clarke, and Jeff Benoit.

And finally, many thanks to all the local, regional, state, and federal officials, planners, scientists, and interested citizens who generously gave of their time and who have made the Massachusetts Bays Program and this CCMP a success.

A copy of the full CCMP will be provided to each of the 49 coastal communities bordering the Bays. It can also be viewed at any Regional Planning Agency office in eastern Massachusetts, or at the Massachusetts Bays Program office.



MASSACHUSETTS BAYS PROGRAM
100 CAMBRIDGE STREET, ROOM 2006
BOSTON, MASSACHUSETTS 02202
1-800-447-BAYS